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A CASE STUDY OF THE AVENGER:
INTEGRATED LOGISTICS SUPPORT (ILS)
OF A
NON-DEVELOPMENTAL ITEM (NDI)

by

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The Avenger System is a lightweight, highly mobile, and transportable surface-to-air missile, operated by a two man crew for defense against helicopters and fixed wing aircraft at low altitude in day or night operations that take place in clear or limited adverse weather conditions. The Avenger system includes eight ready-to-fire Stinger missiles and a .50 caliber machine gun integrated with sensors and target acquisition devices. Boeing's Avenger was selected in August 1987 as the Non-developmental Item (NDI) candidate to perform the Line-of-Sight-Rear (LOS-R) role of FAADS. This thesis examines the Integrated Logistics Support Plan (ILSP) for Avenger that provided essential information for the successful performance of the Avenger Integrated Logistics Support (ILS) activities early in the life cycle of the system. The ILSP provided support requirements for the acquisition of the Avenger. The ILSP addressed the general ILS planning and management functions performed during the production and fielding phases of the life cycle. This thesis also examines Avenger Integrated Logistics Support concepts as a Non-developmental Item. A significant lesson learned is that in order for logistics support to be effective, it must be included in the acquisition planning process and considered in formulation of the acquisition strategy.

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ABSTRACT

The Avenger System is a lightweight, highly mobile, and transportable surface-to-air missile, operated by a two man crew for defense against helicopters and fixed wing aircraft at low altitude in day or night operations that take place in clear or limited adverse weather conditions. The Avenger system includes eight ready-to-fire Stinger missiles and a .50 caliber machine gun integrated with sensors and target acquisition devices. Boeing's Avenger was selected in August 1987 as the Non-developmental Item (NDI) candidate to perform the Line-of-Sight-Rear (LOS-R) role of FAADS. This thesis examines the Integrated Logistics Support Plan (ILSP) for Avenger that provided essential information for the successful performance of the Avenger Integrated Logistics Support (ILS) activities early in the life cycle of the system. The ILSP provided support requirements for the acquisition of the Avenger. The ILSP addressed the general ILS planning and management functions performed during the production and fielding phases of the life cycle. This thesis also examines Avenger Integrated Logistics Support concepts as a Non-developmental Item. A significant lesson learned is that in order for logistics support to be effective, it must be included early in the acquisition planning process and be considered in formulation of the acquisition strategy.

TABLE OF CONTENTS

I. INTRODUCTION

A. BACKGROUND

This thesis examines Integrated Logistics Support (ILS) concepts of a Non-developmental Item (NDI). It focuses on the acquisition process and Integrated Logistics Support of the Avenger. Boeing built Avenger as the U.S Army's Line-of Sight-Rear (LOS-R) air defense system. Avenger is the first of a five component Forward Area Air Defense (FAAD) system being developed by the Army, and was the first to be deployed.

Avenger originally was developed in 1983 and 1984 by the Boeing Company to meet a critical U.S. Army need for an inexpensive, lightweight air defense system with a shoot-on-the-move capability using the Stinger missile.

The system carries eight Stingers in two pods ready for rapid firing from a gyro-stabilized turret. The Army's heavy High Mobility Multipurpose Wheeled Vehicle (HMMWV) is the primary carrier but Avenger is designed to operate in a stand alone configuration or may be mounted on various military vehicles.

Targets are acquired either by direct vision using the heads-up display optical sight or by using a Forward Looking Infrared system.

Boeing submitted its proposal in September 1986 and was awarded a contract by the Army for competitive tests and evaluation of the Avenger.

In August 1987, the Army awarded a first production lot contract to Boeing to build 20 Avenger units. Boeing won in a three way competition to produce Avenger. The first two units were delivered to the Army on schedule in November 1988. Subsequently, the Army exercised five options on the contract, and by December 1993 the total number of Avenger fire units delivered was over 400.

Prior to exercising the contract options, the Avenger met or exceeded all test requirements. These tests included force development testing and partial Initial Operational Test and Evaluation (IOT&E) at Fort Hunter-Ligget, California; final IOT&E and product qualification testing at White Sands Missile Range, NM; and Aberdeen Proving Grounds, MD. Avenger was successful in tests against aerial targets during shoot on the move, stationary and remote operations in both day and night scenarios. Figure 1 provides a graphical depiction of the Avenger System.

Avenger testing proved that the gyro-stabilization system worked as well with guns as with missiles. Following further evaluation, the M3P .50-caliber machine gun manufactured by Fabrique National was chosen for the self-defense gun system for Avenger.

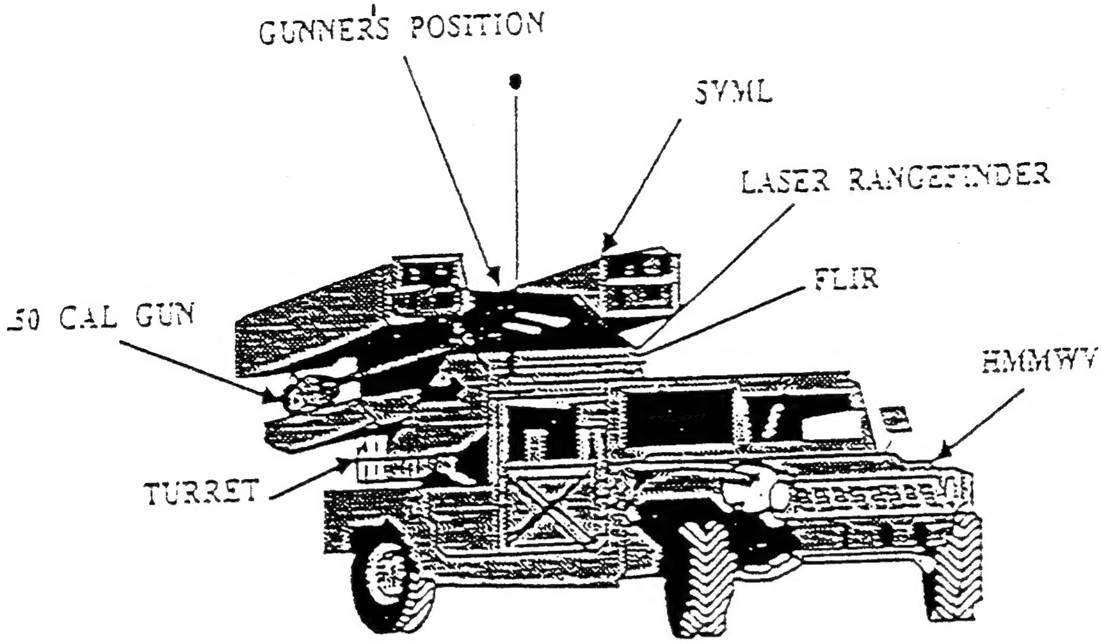

Figure 1. Avenger System. [Ref. 24: p. 5]

Avenger was designed for easy transport. Three systems and their crews can be transported on a C-130 aircraft, while six can be transported on a C-141B aircraft. A CH-47 or CH-53 helicopter can airlift two complete units. Avenger has been certified for single unit airlift by Blackhawk helicopter.

Avenger was developed using several off-the-shelf components already in the Army's inventory. The system has proven its capability in the field while being operated by Army crews with a minimum of training. This prior development and testing of Avenger made it ready for rapid introduction into the U.S. Armed Forces.

In early 1990, Avenger received full-scale production go-ahead from the Army, increasing the production rate from four Avengers per month to 12 per month in October 1991. The Avenger was deployed in the Middle East to support coalition troops during operation Desert Storm following the Iraqi invasion of Kuwait.

In early 1992 the Army signed a multi-year contract for 674 additional units, extending production into 1997. Seventy-nine of those units were delivered to the U.S. Marine Corps. Production of the multi-year units began in October 1992. The Avenger system is assembled, tested and delivered in Huntsville, Alabama, where Boeing Defense & Space Group's Missiles & Space Division facilities are located near the U.S. Army Missile Command at Redstone Arsenal. The Boeing Company's manufacturing facility at Oak Ridge, Tennessee, fabricates the turret assembly and the base assembly that mounts the turret on the HMMWV. [Ref. 1]

In September 1993, the Avenger program was recognized as one of five MICOM Contractor Performance Certification Program--(CP)^{2}--contractors in the nation. The MICOM certification culminated a three year effort by Boeing, MICOM and the Defense Contract Management Command to document contractor performance and customer satisfaction on the Avenger program. The Army's current acquisition plan calls for the purchase of 674 Avenger units. [Ref. 2:p. 2] With U.S. Marine, National Guard and foreign sales, the number

could exceed 1,800. Several foreign countries have expressed interest in the Avenger, and Boeing has demonstrated Avenger's ability to employ a variety of missiles with differing characteristics. An export derivative concept known as Guardian incorporates the Mistral missile produced by Matra Defense of France. [Ref. 1]

B. OBJECTIVES

The objectives of this study are: (1) to determine what influences will cause program managers to choose a NDI to meet operational requirements, (2) to identify the causes for logistics support difficulties when fielding NDIs, and (3) to identify the program parameters that can suggest the most effective support program.

C. RESEARCH QUESTIONS

1. Primary Research Question

How is the decision made to use NDI to meet operational requirements?

2. Subsidiary Research Questions

a. What is non-developmental item acquisition?

b. Because it's a non-developmental item, what makes the logistics different?

c. Which acquisition strategy best meets NDI requirements?

d. What is the impact of NDI acquisition strategy on logistics support?

e. How did the Avenger Program Manager select which support methods best met the Avenger NDI requirements?

f. What ILS methods are used in NDI?

g. What are the lessons learned from the Avenger acquisition?

D. DISCUSSION

The NDI acquisition provides major benefits and challenges to the systems acquisition process and to the user. Benefits include: quick response to operational needs; elimination or reduction of research and development costs; application of state of the art technology to meet current requirements; and reduction of technology, cost, and schedule risks. The challenges that NDI acquisition presents include the possibilities of items, developed for other than DoD needs, not meeting all user requirements and mission performance trade-offs may be required. Additional challenges include providing logistics support, product modifications and continued product availability.

E. SCOPE

This thesis is an analysis of a NDI. This study focuses on all phases of the acquisition process beginning with the

item(s) being placed in the hands of the user, including funding and problems that are incurred.

F. METHODOLOGY

Research data were be obtained from a literature review of related materials. Research was qualitative in nature and was obtained from program managers, users and logisticians taken by telephone and on-site visits at the Avenger Program Manager's Office located at Redstone Arsenal, Alabama. Interviews allowed the researcher to gain data from different levels of management. This thesis will include data from the Integrated Logistics Support Plan (ILSP), existing Government regulations, orders, instructions and policy guidance letters.

G. ORGANIZATION

The organization of this thesis includes an introduction and background of the Avenger, five development chapters, and a final chapter of lessons learned. Chapter II provides the general background and theoretical framework for discussing non-developmental acquisition and logistics support implications for this study. Chapter III explores the potential benefits of using Non-developmental Item (NDI) Acquisition and addresses special support considerations for non-developmental systems. Chapter IV will analyze data in the Integrated Logistics Support Plan (ILSP), existing Government regulations, orders, instructions and policy

guidance letters. Chapter V will describe the major lessons learned from Avenger acquisition strategy. Chapter VI presents conclusions drawn from this research and recommendations.

II. THEORETICAL FRAMEWORK

A. INTRODUCTION

This chapter provides the general background and theoretical framework for discussing acquisition and logistics support implications of NDI. This chapter explores the following areas: an overview of the acquisition process and discusses some of the advantages and disadvantages of a NDI procurement as compared to a non-NDI procurement.

B. ACQUISITION PLANNING PROCESS

This section will discuss the acquisition and non-developmental item acquisition process. The purpose of the acquisition process is to develop, produce, supply, and support weapon systems in order to achieve the operational goals of the Armed Services. The output of the acquisition process is to provide a materiel solution or service to support these operational goals or needs.

The President, Congress, and DoD work to develop and establish these goals as National Security objectives, goals, and policies for the Armed Services. Once these National Security policies are formed, they are incorporated into acquisition policies.

Over the past 25 years it has been the Government's philosophy to rely on the private sector, where practical and

feasible, to meet its needs. [Ref. 3:p. 2] Adoption of non-Government standards, which is in effect an NDI policy, started in 1962 when 12 documents were brought into the DoD system. [Ref. 4:p. 1] In 1972 the Commission on Government Procurement reemphasized the need for a shift in fundamental philosophy toward commercial product acquisition. [Ref. 5:p. 1-1] This approach would allow the Government to avoid the high costs associated with product development, avoid specification development costs, and save on ILS costs by using established commercial distribution channels to support the product. [Ref. 5:p. 1-1]. In 1976 The Office of Federal Procurement Policy adopted all the Commission's recommendations and issued a series of memorandums governing the procurement of commercial products.

Basic guidance for acquisition programs comes from the President's Office of Management and Budget (OMB) which provides program guidance though OMB Circular A-109, "Major Systems Acquisitions".

> In 1982 the Government recognized that a policy needed to be reinstituted toward federal Government reliance on non-Government standards. The Office of Management and Budget (OMB) Circular A-119, Federal Participation in the Development and Use of Voluntary Standards, established new standards policy for Federal agency interaction with non-Government standards bodies and for Government use of their standards. OMB Circular A-119 advocates that voluntary private standards and standards development activities are to be used, promoted, and adopted wherever possible in lieu of Government standards. [Ref. 6:p. 14]

OMB Circular A-119 also directed that:

- Government standards be reviewed every five years.

- An agency seek non-Government standards which can be substituted for any existing or new Government standard.

- Only when existing voluntary standards are found to be inadequate, unacceptable, or not forthcoming can the Government fall back on its own standards and standards writing committees.

C. THE PACKARD COMMISSION

In 1986, the President's Blue Ribbon Commission on Defense Management concluded its study on defense management practices and submitted its report re-emphasizing the recommendations of earlier studies. The Packard Commission report made specific recommendations.

Rather than relying on excessively rigid military specification, DoD should make greater use of components, systems, and services available off-the-shelf. It should develop new or custom made items only when it has been established that those readily available items are clearly inadequate to meet military requirements.

The Packard Commission also noted that the Defense System Acquisition Review Council had been successful in stimulating the use of NDI as an alternative to the continued use of military specifications or the development of unique military products.

The Packard Commission and the 1986 Defense Science Board in a follow-on study titled, "The Use of Commercial Components in Military Equipment," determined that criteria other than product price had to be considered before determining whether to buy NDI, thereby supporting the tenets of OMB Circular A-

109. Life-cycle costs should be used in a contract award decision and items such as item supportability, maintainability, interoperability, warranty, training, and reprocurement must be considered.

D. NATIONAL DEFENSE AUTHORIZATION ACT OF 1987

Based on the above recommendations Congress made it public law in section 907 of the above act that, The Secretary of Defense shall ensure that to the maximum extent practicable--

- requirements of the DoD with respect to the procurement of supplies are stated in terms of:
  - functions to be performed
  - performance required
  - essential physical characteristics
- such requirements are defined so that non-developmental items may be procured to fulfill such requirements; and
- such requirements are fulfilled through the procurement of non-developmental items. [Ref. 7]

The law also officially defined NDI as:

1. Any item of supply that is available in the commercial marketplace.

2. Any previously developed item of supply that is in use by a department or agency of the United States, a State or local Government, or a foreign Government with which the United States has a mutual defense cooperation agreement.

3. Any item of supply described above that requires only minor modification in order to meet the requirements of the procuring agency.

4. Any item of supply that is currently being produced that does not meet the above requirements solely because the item is: (1) not yet in use or, (2) not yet available in the commercial marketplace.

The law also tasked DoD to enforce this legislation on the Services, as well as to identify and remove where possible any statutes and legislation that may impede the effectiveness of this initiative.

Today, this guidance is reflected in DoD directives. DoD Directives 5000.1, "Major and Non-Major Defense Acquisition Programs," and DoD 5000.2, "Defense Acquisition Program Procedures," establish general policies and procedures for managing major and non-major defense acquisition programs. These documents expand OMB Circular A-109 and are designed to provide a single, uniform system for planning, designing, developing, procuring, maintaining and deposing of all equipment, facilities and services for DoD. These polices help forge a closer, more effective interface among DoD's two major decision making support systems affecting acquisition: (a) Requirements Generation System and (b) Acquisition Management System.

These characteristics and relationships define the integrated management framework for defense acquisition. The following elements of the decision making are circumstances change.

When the acquisition process identifies a need for a new hardware system, the acquisition begins with the necessary requirements documents. Once a need is identified that requires a materiel solution, non-developmental item acquisitions are one of the first strategies considered.

Acquisition programs can begin in a number of different ways. For example:

- Replacement for an existing system that has become obsolete.
- A new threat is identified that requires a new system design to counter that threat.
- DoD's missions change which requires new equipment. New technology is inserted into existing programs or sparks the development of new systems.

1. Mission Area Analysis

The acquisition process begins with a Mission Area Analysis (MAA) which is conducted by the Service component. The Mission Area Analysis is a continuing process that identifies the perceived threat, technology changes, and inputs from operational personnel that may indicate a modification to existing equipment or development of a new system. This analysis may indicate the Service component (also known as the user) has a deficiency or need that requires a military doctrine change or a materiel solution. If a doctrine change is not the solution, then a materiel solution is considered. The Mission Area Analysis comes into play again because a market surveillance is conducted as part of the MAA. The commercial market is reviewed for technology

and systems that may fulfill operational requirements. Thus, market surveillance helps DoD to avoid some of the costs associated with research and development efforts if commercial products and services can be purchased directly from industry.

Following MAA, the mission need is formally documented in a Mission Need Statement (MNS), Operational Requirement (OR), or Required Operational Capability (ROC), which defines the need for a new or modified weapon system capability

[Ref. 8:p. 6]

2. Mission Need Statement

The Mission Need Statement (MNS) documents a mission need to correct a warfighting deficiency. Required for all potential programs requiring a materiel solution, major and non-major. [Ref. 9:p. 31]

The Mission Need Statement defines projected needs in broad operational terms. The intention of the MNS is to identify a need that requires some solution. These broad statements are continually refined as they progress though the acquisition process and become more detailed as they pass through successive decision points.

These statements are forwarded through established review channels to the Joint Requirements Oversight Council which is chaired by the Vice Chairman of the Joint Chiefs of Staff. The Council reviews each Mission Need Statement to determine if a materiel solution is necessary. If a MNS is confirmed by

the Council, it is forwarded to the Under Secretary of Defense for Acquisition and Technology (USD(A&T) for approval. Next, the (USD(A&T) may send the MNS to the Defense Acquisition Review Board who may recommend proposed solutions for further study at a Milestone 0 decision review. [Ref. 8:p. 1-2]

E. ACQUISITION MANAGEMENT

The interaction between requirements generation and acquisition management continues through structured logical phases separated by major decision points, called milestones. [Ref. 8:p. 2-5] This management system provides a streamlined management structure that is an event-driven acquisition process linking milestones decisions to demonstrate accomplishments. [Ref. 8:p. 1-2] This interaction continues through subsequent phases and milestones and can span several years for a classical acquisition program. [Ref. 8:p. 2-7]

F. ACQUISITION MILESTONES & PHASES

The acquisition phases provide a logical means to progressively translate broadly stated mission needs into well defined system-specific requirements. The focus of these activities are to orient and tailor to the establishment of the minimum required accomplishments, program-specific exit criteria, and program objectives: "The acquisition strategy shall be tailored to meet specific needs of individual

programs consistent with the policies established in DoD Directive 5000.2". [Ref. 10:p. 5-A-1]

At Milestone 0, the Mission Need Statement has been approved to start a new program, signifying the beginning of the Concept Exploration/Definition Phase (CE/D). Normally the Service component establishes a program office to develop, produce, deploy, and support the new system. The Program Manager (PM) selects alternative concepts and writes an acquisition strategy to be pursued based upon Mission Area Analysis, Mission Need Statement, and the Operational Requirements Document.

The program office evaluates alternative concepts as to their potential life cycle cost, development schedules, and performance characteristics. At this time, the PM should begin to consider non-developmental alternatives. The PM then selects the best concepts based upon their feasibility, technical risk, and cost trade-offs for additional studies.

A favorable decision at Milestone I, Concept Demonstration Approval, marks the establishment of a new program Concept Baseline. The Concept Baseline includes minimum performance criteria outlined in the Operational Requirements Document and includes cost and supportability constraints. Milestone I approval allows the program to proceed to Phase I, Demonstration and Validation (DEM/VAL).

Some of the objectives of DEM/VAL are to define critical design characteristics and to demonstrate critical processes

and technologies before proceeding into the next program phase. It is during this phase that prototypes are usually built and tested. A prototype is an original or model on which a later item is formed or based.

The program proceeds to Milestone II, Developmental Approval, once the Phase I exit criteria are met. Milestone II establishes a Developmental Baseline. The Developmental Baseline is a refinement of the Concept Baseline that it now replaces. Program cost, schedule, and performance objectives are approved for continuation into the next phase. Also, Low-Rate Initial Production (LRIP) quantities are identified, if applicable. LRIP is a limited production quantity designed to establish an initial production base and to permit an orderly increase in the production rate sufficient to lead to full-rate production later. [Ref. 11:p. B-11] LRIP is also a good tool to measure the logistics support system before going into full-rate production. Upon successful completion of Milestone II, the program enters the third phase, Phase II, Engineering and Manufacturing Development (EMD). In this phase, the system/equipment and the principal items necessary for its support are fully developed, engineered, designed, and fabricated. EMD translates the most promising design approach into a stable, producible, cost effective system design.

Manufacturing and production processes are demonstrated and validated through a test and evaluation system. [Ref. 10:p. 3-21] A program may enter Milestone III, Production and

Deployment, if the performance objectives are validated with satisfactory test results and LRIP provides reasonable assurance that the design is stable and capable of being produced. The program should achieve an operational capability that satisfies the mission need at this point. Follow-on operational and production verification testing are conducted to verify production quality and to correct any deficiencies. [Ref. 10:p. 3-27]

Once the system is fielded, modifications may be required because the threat changes, a deficiency is identified, or because of a need to reduce operational costs. Approval of Milestone IV, Major Modification Approval, means that a major modification or system upgrade is approved for a system that is still being produced. Now the program can enter the fifth phase, Phase IV, Operations and Support. The objectives of this phase are to support the fielded system, monitor system performance, identify improvement opportunities, and modify the system as required. The system remains in this phase until system disposal is approved.

G. NON-DEVELOPMENTAL ITEM ACQUISITION

1. General

Non-developmental item is a generic term that covers materiel available from a wide variety of sources with little or no development effort required by the Government. [Ref.

12:p. 1-3] A simple definition of Non-developmental items are those items already developed and are capable of fulfilling requirements "as is" or with some "minor modification."

The Army segregates non-developmental items used into three categories:

- Category A. Off-the-shelf items used in the environment for which the items were designed with little or no development required.
- Category B. Off-the-shelf items used in an environment different from which the items were designed.
- Category C. Integration of existing components and essential engineering effort to integrate the systems. [Ref. 14]

NDIs are acquired primarily since they eliminate the need for costly and time-consuming development programs. Non-developmental item acquisitions have lower life cycle costs because NDIs can usually skip most of the research and development phases of the acquisition process. In addition, legislation exists advocating the use of NDI acquisition alternatives. NDI acquisition covers a spectrum of materiel alternatives since rapidly changing commercial technologies expand the potential for high quality and low cost commercial items to satisfy military requirements. [Ref. 14:p. 4] The electronics and personal computer markets are good examples of how high-tech and high quality items can be introduced and upgraded within a very short time. These commercial industries are able to introduce new technology rapidly

because they have developed their own independent research and development capabilities.

These NDI markets provide opportunities for the Government to reduce research and development costs since these commercial industries are conducting their own research and development programs. These concepts are used in other markets as well. Therefore, NDI acquisition offers many possible solutions to materiel needs because of this broad resource base.

2. Non-Developmental Item Preference

Non-developmental item acquisition challenges the traditional practice and cultural mindset of buying and developing only military unique items. NDI acquisition allows for greater flexibility and lower life cycle costs in the procurement process. [Ref. 15:p. 14] The Department of Defense can no longer afford to restrict the acquisition process to military unique developmental efforts. NDI acquisition will not always be the optimum solution to DoD's materiel needs. However, when NDI is the choice, DoD is afforded the opportunity to tailor its needs, such as, tailoring the logistics support structure for each NDI acquisition. Non-developmental item acquisition, as a concept, correlates to the movement of commercialization in the DoD acquisition environment because NDI has opened the door to a wide range of commercial alternatives to best meet

the Government's needs. In 1976, the Office of Federal Procurement Policy directed Government Agencies to purchase commercial products if they adequately satisfied the Government's needs. This fundamental shift toward commercial products continued when the President's Blue Ribbon Commission on Defense Management (Packard Commission) recommended that the Government make greater use of commercial components, systems, and services available "off-the-shelf" in 1986. [Ref. 15:p. 9] The 1987 Preference Act reinforced a preference for non-developmental items and required the DoD to state materiel requirements in terms of function to be preformed, performance required, and essential physical characteristics. [Ref. 12:p. 1-2] The intention of this legislation was to insure that NDI alternatives are given consideration as solutions to materiel needs.

The Committee on Government Affairs stressed the need for DoD to expand the use of commercially available products and minimize research and development costs in 1989:

> Too often, the Department of Defense continues to subject commercially available parts to complex military specifications and, as such, requires contractors to reinvent a unique military specification wheel when a commercially available wheel can perform the task just as well. [Ref. 16:p. 1]

The 1991 Defense Authorization Act required DoD to conduct market research prior to developing new specifications to determine if non-developmental items are available to meet identified needs. This measure was implemented to stimulate

the use of non-developmental item alternatives instead of developing a unique military product. [Ref. 15:p. 10]

3. Classical Acquisition Versus NDI Acquisition

On average, an NDI acquisition cycle takes two and one-half to five years, while classical research and development cycles take eight to sixteen years. NDI acquisition saves time in the acquisition process because the Demonstration and Validation and Engineering and Manufacturing phases can be combined or eliminated. A four to nine year cycle can be compressed into a one to two year phase. [Ref. 17]

The second phase (DEM/VAL) of the acquisition process can be skipped because the commercial developer has usually conducted design, research and development, integration, logistics support, and test and evaluation efforts. Time in phase three (EMD) may be reduced if some item modification is required to meet a military requirement. In this case, the developer must demonstrate the capabilities of the NDI modification and prove capabilities to produce in the required quantities. [Ref. 17]

4. Advantages of Non-Developmental Acquisition

Non-developmental item acquisition capitalizes on the use of commercial "state-of-the-art" technologies while providing DoD with effective and economical solutions to operational requirements. NDI acquisition offers quick

responses to operational needs because they have shorter acquisition cycles. [Ref. 15:p. 12] Testing requirements may be reduced because some of the commercial manufacturer's test and performance data can be used to prove military suitability.

Another advantage for using non-developmental item acquisition is that NDI has shown quality trends in the commercial world to be as good if not better than specially developed items when they are purchased to meet a military requirement. [Ref. 18:p. 5]

NDI acquisitions tend to have lower life cycle costs because of the limited Research & Development (R&D) cost, use of commercial specifications, and competition in the commercial market. NDIs are uniquely structured to take advantage of the competitive forces in the market place because the Government becomes another buyer in a market with many suppliers. Many PMs prefer non-developmental items because they are able to project funding requirements more accurately when non-developmental items are part of the acquisition strategy. Theoretically, off-the-shelf prices are firm. Therefore, the program manager may project a schedule and a budget with minimum risk of being wrong.

5. Disadvantages of Non-Developmental Acquisition

Each non-developmental item acquisition must have an individual support strategy and be incorporated into the

acquisition strategy early on. Acquisition planning must ensure that logistics and support concerns are satisfied before a decision is made to buy commercial products. Non-developmental item acquisition is not without potential problems and risk.

Some major problems concern configuration control and obsolescence. These problems can be associated with rapidly changing technologies like computer equipment. New products can be introduced and discontinued in a short time. NDI product configuration information often lags behind or falls victim to obsolescence which makes management of configuration integration difficult. [Ref. 3:p. 5]

Sustainability problems can arise if repair parts and replacement items are not compatible with existing systems or support systems. If repair parts and replacement items are not interchangeable, additional spares and replacement parts will have to be introduced into the support system.

Inadequate market research may result in the failure of the product to meet performance or logistics support requirements. The market survey identifies a material alternative that is "good enough," not necessarily the best product. [Ref. 19:p. 10] As more and larger modifications are required, the intended benefits may rapidly disappear and the cost savings are lost. [Ref. 18:p. 4]

Design stability is another concern because much of the research and development effort is conducted by the

commercial developer. Many high-tech electronic products can be introduced into the marketplace very rapidly. Test and evaluation of the design could be incomplete because of the pressures to get the product into the market before a competitor does.

6. Examples of Non-Developmental Items

There are a number of examples of non-developmental item acquisitions. The simplest NDI starts with off-the-shelf items and increase in complexity to full scale development. The Army's Beretta 9mm pistol is an example of an "off-the-shelf" item. The Army's Mobile Subscriber Equipment (MSE) is an example of subsystem and component integration. The Army's Forward Area Air Defense System (FAADS) Avenger is an example of development with NDI piece parts. [Ref. 15:p. 11] The PATRIOT air defense missile system, in comparison, is an example of a classical or full development program.

The predominant use of non-developmental items is related to the insertion of an NDI subsystem, component, and piece part levels in major developmental efforts [Ref. 12:p. 2-3]. There are many commercial market areas that are well-suited for non-developmental item acquisition: computers, power generation, test measurement equipment, transportation and communications equipment, and navigational equipment. [Ref. 20:p. 15]

H. CHAPTER SUMMARY

This chapter discussed the differences between classical acquisition and NDI acquisition strategies. Classical research and development programs take much longer than NDI programs to field. NDI programs are fielded much faster because most of the development phases are eliminated. Testing and production can begin much sooner. NDI programs are less expensive because development costs are saved.

III. NDI LOGISTICS SUPPORT REQUIREMENTS

A. INTRODUCTION

This chapter explores the potential benefits of using Non-developmental Item (NDI) Acquisition and addresses special support considerations for non-developmental systems.

It is important to understand the NDI support methods and how they are applied. The entire process of planning and acquiring logistics support must be tailored to the programmatic constraints inherent in the non-developmental item being supported. The Logistics Support Analysis is an important tool that can be used to identify support requirements and constraints of a system. This analysis helps design the Integrated Logistics Support Plan that is the Government's formal logistics support planning document for a program. Much of a program's success in the operational phase is dependent upon the quality of the support analysis and support planning. Inadequate support plans cause increased operating costs.

B. INTEGRATED LOGISTICS SUPPORT (ILS)

Integrated Logistics Support is a disciplined, unified, and iterative approach to the management and technical activities necessary to:

- Integrate support considerations into system and equipment design.
- Develop support requirements that are related consistently to readiness objectives, to design, and to each other.
- Acquire the required support.
- Prove the required support during the operational phase at minimum cost. [Ref. 13:p. 41]

The Program Manager is assigned the responsibility to establish and manage an adequately funded ILS program. ILS policy emphasizes readiness implications (a system's capability to perform its wartime mission) early during system development. The early identification of readiness and supportability design parameters is necessary to achieve system readiness objectives at an affordable cost. [Ref. 9:p. 1-1]

The ILS program will address the impact of support costs upon the total system cost, known as the Life Cycle Cost (LCC). LCC includes research and development costs, production and construction costs, operational and maintenance costs, system retirement and phase out costs. All these factors influence the maintenance concept and logistics support for the system. The concept chosen to meet the operational requirement locks in approximately 70 percent of a system's LCC during the operational phase. [Ref. 11:p. 6-4] NDI programs are constrained because they do not have any input into system design. The commercial developer's

decisions during the design process may restrict the program's support options.

C. INTEGRATED LOGISTICS SUPPORT PLAN (ILSP)

The Acquisition Strategy is the program's plan for satisfying the user's need. The acquisition strategy must make effective use of available financial, technological, and commercial resources. NDI support factors include the maintenance concept for the entire system that capitalizes on existing facilities and equipment and incentives for commercial repair to minimize cost if applicable.

The Integrated Logistics Support Plan (ILSP) is a key factor in successfully fielding and supporting a system. The ILSP covers all the logistics activities for the life of the system from contractor to organic support, if applicable. [Ref. 10:p. 7-A-2-4] The parameters used in determining support resource requirements are traceable to program objectives and thresholds presented in the acquisition strategy [Ref. 10:p. 7-A2-3] The ILSP should reflect the NDI's support strategy.

D. LOGISTICS SUPPORT STRATEGIES FOR NDI

There are four methods that can be used to provide logistics support for non-developmental items:

- No support required.
- Total contractor support.

- Organic support.
- A combination of organic and contractor support.

The decision regarding the support method should be made as early as possible in the life of the program so that the contracts may be structured to facilitate the required system support. The support methods and their advantages and disadvantages are presented below.

1. No Support (NS)

This support method works by not repairing equipment regardless of the type of failure. Instead, the item is replaced with a spare when it fails. Items designated to receive this method of support are called "non-repairable items" Choosing this support method implies that the cost of spare units and disposal is cheaper than repairing the system to a "ready-for-use" condition. [Ref. 11:p. 16-2] The components used to make the system are usually low cost items which justifies disposal (when they fail).

A non-repairable system is normally modular in construction with easily removable sub-components. Fault detection and isolation of failed components should be easy because the user discards the system after it fails. A self-test capability is important. The self-test should be thorough and confirm failures before discarding the system or this could be expensive.

a. *Advantages*

The no support method offers some advantages because this method requires minimal logistics support. Lower level spare parts are not required because the entire unit is replaced. The only maintenance test equipment required is limited to initial system check-out and ready-for-use certification. There is no need for internal accessibility, test points, plug-in sub-assemblies, or maintainability enhancements. Low personnel maintenance skills are required because maintenance actions are limited to removal and replacement functions.

b. *Disadvantages*

The decision to implement this support concept should consider its effects during conflicts and peacetime environments. If the system is not to be discarded upon failure during wartime, other support concepts should be considered. It could be difficult to set up a different support system during a conflict. New item, new maintenance equipment, and maintenance training would be required to implement a new support system. To minimize these potential difficulties, a total discard upon failure system should be used in peacetime, as well as wartime.

Inventory stock levels for replacement spare units must be maintained for rapid replacement. Repairs would be difficult because replacement parts are not stocked.

Transportation time requirements could also affect the replenishment of inventory stock during times of high demand. If inventory replenishment lags behind inventory demand requirements, stockage levels will fall or zero out. This causes inadequacies in the support system, which could be critical in wartime environments.

2. Total Contractor Support (TCS)

Total Contractor Support involves establishing contractual responsibility for all system maintenance with a commercial contractor if an item fails and the contractor is responsible for restoring the item to working order. Total contractor support is more applicable for systems operating in a non-combat environment because they are normally conducted at the contractor's facility far from combat locations. [Ref. 11:p. 16-4]

There are some common characteristics with equipment that is best supported by total contractor support. Total contractor support will work well for items that are too expensive to discard upon failure and when other support methods are not practicable. Total contractor support may also be appropriate in systems where the relative frequency of failure is low.

a. Advantages

By using total contract support, the contractor assumes the risk for any failures during the contract period.

Other advantages are that the Government would not require tools and test equipment because the contractor provides ready-for-use certification and performs all repairs. [Ref. 11:p. 16-3] Inventory systems are reliable because spare units can be stored on site or at the contractor's facilities. Military maintenance personnel requirements can be reduced since the contractor does all the repair work.

b. Disadvantages

Total dependency upon the contractor means accepting possible risks in excessive maintenance costs, quality instability (internal design changes and substitute components), untimely and inadequate support (if too far from repair facilities), and system upgrades that may not be compatible with existing equipment. If the system has a high failure rate, then the maintenance costs will increase because more repairs are required. The price for this type of support can be expensive. The support system should be transportation intensive in order to replenish spare system inventories, repair and return systems to the user. The program manager must consider these impacts on the logistical areas when this support method is chosen. [Ref. 21:p. 112]

3. Organic Support (OS)

Organic Support for a military organization implies that the organization has internal resources in place and the required maintenance skills to operate their own support

systems. The organization performs all maintenance tasks on the system. Normally, the organization identifies maintenance problems, repairs/replaces systems, maintains spare parts and spare system inventories. Historically, DoD has used organic support for most systems and equipment.

Traditional logisticians expect that organic support is the mandatory option. This may be true for some systems and generally can be accomplished for all systems if cost is not a consideration. But efficient and effective support depends upon their ability to influence system design and parts selection. Otherwise, we accept the risk of costly sole source parts supply, including maintenance manuals, and testing equipment of costly acquisition, if available, of technical data and a system design freeze to a baseline with additional costs to maintain the production base.

Organic Support is organized into three levels of maintenance: organizational, intermediate, and depot maintenance. Organizational level maintenance is conducted by the activity (organization) which actually uses the equipment, within the activity's capability. Maintenance is limited to equipment performance checks, external adjustments,and removal or replacement of some components. The least skilled personnel are assigned to these tasks.

Intermediate maintenance is performed by mobile, semi-mobile, specialized organizations and installations. At this level, tasks may include repair of end items by removal

or replacement of major assemblies, modules, or piece parts. Additional test and support equipment and more spares are required. Intermediate level maintenance personnel perform more detailed maintenance tasks than organizational level personnel.

Depot maintenance is the highest level of maintenance because it supports the accomplishment of tasks above the capabilities of intermediate and organizational levels. The depot may be a specialized repair facility supporting many systems and may be the manufacturer's plant. These facilities are fixed installations and can handle bulky equipment and large numbers of spare parts. Depot level maintenance is capable of complete overhauling, rebuilding, and calibration of equipment. [Ref. 21:p. 116]

a. Advantages

The initial investment for organizational support can be very large because the Government may need to build facilities and buy repair equipment. However, organizational support may be less expensive and more effective in the long run for NDIs. Organizational support has the infrastructure to support systems that have high failure rates and large populations. Large volume inventory capabilities, repair skills and repair equipment, and military transportation assets enable organizational support to support these high demands regularly. Organic Support is better suited for

combat environments because maintenance operations and organizations are located near combat units. If a system is needed for some future application, the Government may choose to develop the organic support capability. Some of the existing support capabilities and facilities could then be used reduce the time required to develop a new support program.

b. Disadvantages

By using Organic Support, the Government develops the complete support program and bears the risk for system failure. [Ref. 11:p. 16-4] The Government may need to obtain technical data for the system to design a logistics support system. This information determines the number of spares components and spare parts, and maintenance skill required. [Ref. 11:p. 7-9] This type of requirement needs sufficient operational or historical data to justify the initial investment. The system has to be repairable or offer some salvage value. NDIs have a shorter acquisition cycle and usually require interim support before organic support methods can be designed and implemented.

4. Organic and Contractor Mix

The Organic and Contractor Mix method involves the sharing of system failure between the Government and the contractor. Maintenance responsibilities may be shared in any manner that is beneficial to the Government. Usually the

Government assumes the organizational maintenance tasks and the contractor assumes the depot maintenance functions.

a. *Advantages*

The Organic and Contractor Mix support is best suited for systems that do not fall into the non-repairable category and are not best served by total contractor support. This support method would be more applicable to long life cycle items not subject to rapid state-of-the-art technology changes.

A system requiring a phased support system could be considered for an Organic and Contractor Mix method. Phased support allows a program to design the support structure incrementally, according to the availability of maintenance assets. A program choosing organic support may require time to develop the required support assets. Initial support would be provided by the contractor until the system transitions to organic support or to an Organic and Contractor Mix.

b. *Disadvantages*

A significant concern of using an Organic and Contractor Mix support concept is controlling the transition from a particular support method to another method. The requirements between the Government and the contractor must be clearly defined and understood by all parties. Misunderstandings could cause scheduling delays and increase costs.

E. LOGISTICS SUPPORT ANALYSIS FOR NDIs

Logistics Support Analysis (LSA) is an iterative analytical process by which logistics support necessary for a new system is identified and evaluated. LSA is a part of the systems engineering process that ensures that system design and supportability requirements are integrated early in the system. As a design analysis tool, it is employed throughout the early phases of system development and often includes maintenance analysis. The quantitative methods of LSA have applications in the following areas:

- Initial determination and establishment of logistics criteria as an input to system design.

- Evaluation of design alternatives.

- Assessment identification and provisioning logistics support elements.

- Final assessment of system support capabilities.

An output of LSA is the identification and justification for logistics support resources: spare/repair part types and quantities, test and test support equipment, and personnel skill-level requirements. This output is called the Logistics Support Analysis Record (LSAR). [Ref. 21:p. 14] The LSAR is a formal tool under MIL-STD 1388-2A to document operations and maintenance requirements. The LSAR is the basis for training,

personnel, supply provisioning, support equipment acquisition, facility construction, and maintenance tasks.

The following logistics support elements should be considered in the Logistics Support Analysis for NDIs:

- Reliability.
- Availability.
- Maintainability.
- Standardization.
- System use.
- System environment.
- System operation.
- System maintenance level.
- System cost.

1. Reliability

Reliability is the duration or probability of failure-free performance under given conditions. It is expressed in terms of mean-time-between-failure (MTBF), except for one-shot devices when probability is used. Reliability is a design attribute. This definition stresses the elements of probability, satisfactory performance, time and specified operating conditions. These four elements are extremely important because each plays a significant role in deciding system and or product reliability. [Ref. 16:p. 14]

a. *Probability*

Probability is usually stated as a quantitative expression representing a fraction of a percent signifying the number of times that an event occurs (successes), divided by the total number of trials.

When there are several identical items operating under similar conditions, it can be expected that their failures will occur at different points in time. The fundamental definition of reliability is heavily dependent upon the concepts derived from probability theory. [Ref. 21:p. 15]

b. *Satisfactory Performance*

Satisfactory performance suggests that specific criteria must be established which describe what is considered satisfactory system operation. A combination of qualitative and quantitative factors defining the functions that the system is to accomplish, usually presented in the context of a system specification, are required. [Ref. 21:p. 15]

c. *Mission Time*

Mission Time is an important element since it represents a measure against which the degree of system performance can be related. One must know the "time" parameter in order to find the probability of completing a mission or a given function as scheduled. Of particular interest is being able to predict the probability of a system surviving

(without failing) for a designated period. Also, reliability is frequently defined in terms of mean time between failure (MTBF) and mean time between maintenance (MTBM). [Ref. 21:p. 15]

MTBM is a basic technical measure of reliability. MTBF is the total functional life of a population of an item divided by the total number of failures within the population, for a particular interval. This definition holds true for time, rounds, miles, events, or other measures of life units. [Ref. 21:p. 18]

MTBM is the mean or average time between all maintenance actions (corrective and preventive). Corrective maintenance includes all unscheduled maintenance actions performed as the result of a system failure, to restore the system to a specified condition. These actions include failure identification, repair and replacement, checkouts, and condition verification. Preventive maintenance includes all scheduled maintenance actions performed to retain a system in a specified condition. Preventive actions include periodic inspections, critical item replacements, and calibration. [Ref. 21:p. 18]

d. *Specified Conditions*

Specified conditions may include several environmental factors such as geographical location, operational profile, transportation profile, temperature cycles, and

humidity. These factors must not only address the condition for the period when the system is operating, but also the conditions when the system is in a storage mode or being transportated from one location to the next. Experience has shown that the transportation, handling, and the storage modes are sometimes more critical from a reliability standpoint than conditions experienced during the actual system operational use. [Ref. 21:p. 15]

These four elements are critical in determining the reliability of an NDI system. System reliability is a key factor in the frequency of maintenance, and the maintenance frequency obviously has a significant impact on logistics support requirements. Reliability predictions and analyses are required as an input to the LSA. Reliability is an inherent characteristic of design. NDIs do not have input into system design. It is essential that reliability be addressed throughout the system life cycle. [Ref. 21:p. 15]

2. Availability

Availability is often used as a measure of system readiness, i.e., the degree, percent, or probability that a system will be ready or available when required for use. It is the probability that the system is operating satisfactorily at any point in time when used under stated conditions, where the total time considered includes operating time, active repair time, administrative time, and logistics time. This is

often called "operational readiness." Operational readiness affects the number of spares and spare parts required to reduce repair times. The NDI support method must consider availability requirements. [Ref. 21:p. 69]

3. Maintainability

Maintainability is an inherent characteristic of a system design, like reliability. Maintainability pertains to the ease, accuracy, safety, and economy in the performance of maintenance actions. A system should be designed in a way that it can be maintained without large investments of time, cost, or other resources (e.g., personnel, facilities, materials, test equipment) and without affecting the mission of that system. Maintainability is the ability of an item to be maintained. Maintenance constitutes a series of actions to be taken to restore or retain an item in an effective operational state. Maintainability is a result of design. [Ref. 21:p. 17] The system determines the maintainability requirements, not the support method. A NDI program must analyze maintainability requirements before choosing a support method. Maintainability requires the consideration of many different factors involving all aspects of the system, and the measures of maintainability often include a combination of the these factors.

a. *Mean Time Between Maintenance (MTBM)*

MTBM is the mean or average time between all maintenance actions, corrective and preventive. It includes consideration of reliability MTBF and Mean Time Between Repair (MTBR). The maintenance frequency factor, MTBM, is a major parameter in determining system availability and overall effectiveness. [Ref. 21:p. 17]

b. *Mean Time Between Repair (MTBR)*

MTBR is a factor of MTBM, and refers to the mean time between item replacement and is a major parameter in deciding spare part requirements. A maintainability objective in system design is to maximize MTBR where feasible. [Ref. 21:p. 49]

c. *Logistics Delay Time (LDT)*

LDT is the maintenance downtime expected as a result of waiting for spare parts to become available, waiting for the availability of test equipment required to perform maintenance, waiting for transportation and waiting to use a facility required for maintenance. LDT does not include active maintenance time. It is a major element of total maintenance downtime and could be significant for NDIs. [Ref. 21:p. 49]

d. *Administrative Delay Time (ADT)*

ADT refers to that portion of downtime during which maintenance is delayed for reasons of an administrative

nature: personnel assignment, labor strike, organizational constraint, etc. ADT does not include active maintenance time. [Ref. 21:p. 49]

e. Maintenance Downtime (MDT)

Maintenance downtime is the total elapsed time required (when a system is not operational) to repair and restore a system to full operating status, and/or to retain a system in that condition. MDT includes mean active maintenance time, LDT, and ADT. [Ref. 21:p. 47]

4. Standardization

The Government may purchase several different systems to meet the same needs of different organizations when relying upon the commercial market. For example, consider the purchase of an office typewriter. Many commercial firms manufacture typewriters. If a Government organization had a requirement for one, it would not develop it from a typical research and development approach. Instead, the organization would buy directly from the manufacturer to save unnecessary research and development costs. Unless the organization specified some level of compatibility with existing typewriters, they may end up buying a model that is not compatible with typewriters currently in use. This causes a logistics support problem because the agency would have to stock at least two different types of ribbons for the different typewriters. [Ref. 21:p. 30]

Hardware and software proliferation is one area of NDI where systems must be compatible and interchangeable or readiness can be affected. Standardization of equipment should be an important consideration because of the impact upon spare part inventories. A Form, Fit, Function (F^3) analysis can be a valuable tool because requirements can be evaluated in functional terms, such as, speed, range, weight, and other characteristics. In addition, an F^3 analysis can enable NDIs to support multiple systems having the same or similar performance requirements. Standardization would be promoted and increase the need for the logistics support system to carry several different groups of spare parts to support these items.

5. System Use

The degree of militarization affects the potential benefits of an NDI acquisition. As the military version differs more and more from the commercial version, the benefits of NDI diminish. Military modifications could mean an increase in system complexity and cost. Additional tests could be required which can also increase cost and delay the fielding schedule. As the degree of militarization increases, the need for an organic support system increases.

6. System Environment

The environment that the non-development item operates in is important. This factor can be divided into two catego-

ries: hostile and benign. If the NDI system is to be used in direct combat operations, a total contractor support system may be very difficult to implement. The contractor would be brought into a combat environment to provide service. However, contractor maintenance service is possible if systems can be moved from the battlefield to a more benign environment. A benign environment favors total contractor support. The cost of this service in a benign environment would not include the cost of training support personnel in combat techniques. However, combat training may be a part of the cost for organic support. The closer this environment is to the commercial environment, the more DoD can rely on commercial support as an option.

7. System Operating Cycle

Usually, long operating cycles for systems indicate a mission of a routine and ongoing nature. For systems that fall into this category, service cycles can be planned in advance, which makes total contractor support easier for all systems than with systems with short cycles. Short operating cycles usually suggest intermittent, randomly scheduled missions. These systems tend to spend a great deal of time in stand-by status. For these systems, support services cannot be conveniently scheduled in advance. Systems with short operating cycles are better served with an organic system.

8. System Maintenance Level

This factor describes the level of maintenance where most system repair will occur. A no support system is favored when most of the maintenance actions are expended at the organizational level. A mix support system may be preferred if the system is mostly repaired at the intermediate and depot levels. If most of the repairs were at the intermediate level, the Government would develop an organic intermediate level capability and contract the depot level maintenance.

9. System Cost

Two broad categories comprise life cycle costs. They are recurring and non-recurring costs. Recurring costs are those life cycle costs attributable to individual systems because each system has its own operational and support costs. In turn, each system procured increases the operational and support costs associated with that system. These costs and maintenance costs will affect the NDI support method. [Ref. 21:p. 35]

F. CHAPTER SUMMARY

This chapter addressed the potential benefits of using non-developmental item acquisition and the support considerations for non-developmental systems. The support method selected must be tailored to the constraints inherent in the non-developmental item being supported. The Logistics Support Analysis is an important tool that can be used to identify NDI

support requirements and constraints of a system. This analysis helps design the Integrated Logistics Support Plan for an NDI program.

IV. AVENGER INTEGRATED LOGISTICS SUPPORT PLAN (ILSP)

A. INTRODUCTION

The Avenger ILSP is a management tool that delineates anticipated future logistical planning actions by the program office and external supporting activities. It is the foundation document for coordinating logistics planning efforts to ensure that each of the ILS elements are addressed and integrated with the other elements throughout the program's life cycle. The Avenger ILSP contains the details which form the basis for specific actions by supporting activities and for developing logistical requirements to be included in contractual documents. [Ref. 17] It also, provides the foundation for coordinated action on the part of the Logistics Element Managers and the contractor, and documents the manner in which each of the applicable elements of logistics support is to be obtained, integrated with the other elements, and sustained throughout the life cycle. [Ref. 17]

B. SYSTEM READINESS OBJECTIVE

The following System Readiness Objective (SRO) requirements apply to the Avenger Fire Unit (FU) and Subsystem when operated in accordance with the Operational Mode Summary/Mission Profile (OMS/MP). The Avenger contractor is not responsible for demonstrating Government Furnished Property

(GFP) reliability other than the integration of hardware and software interfaces. The Avenger should be able to move, shoot, and communicate to be Full Mission Capable (FMC). [Ref. 22:p. 2-3]

1. Built-in Test(BIT)/Built-in Test Equipment(BITE)

BIT/BITE will detect and isolate faulty LRUs. Baseline BIT/BITE will detect at lease 80 percent of all mission failures (less vehicle and communication equipment) with a false alarm rate not to exceed 29 percent. BIT/BITE will isolate the detected failures to a single LRU 60 percent of the time. Eighty percent of the detected failures must be isolated to a prioritized list of no more than five LRUs. BIT/BITE will include growth capability so that the mature FU (IOC + 2 years) will include BIT to detect at lease 90 percent of all mission failures (less vehicle and communication equipment) with a false alarm rate not to exceed 10 percent. BIT will isolate the detected failures to a single LRU 72 percent of the time. Eighty-one percent of the failures must be isolated to a prioritized list of no more than five LRUs. The remaining 19 percent of mission failures not isolated by BIT will be isolated using manual isolation procedures and technical data. The BIT capability of the SVML Subsystem and SVML Interface Electronics Subsystem will be integrated with weapons platform BIT and will not be degraded. [Ref. 22:p. 2-3]

C. AVENGER ACQUISITION STRATEGY

The acquisition approach was to obtain the Avenger System as an NDI through the competitive procurement process by performing a candidate evaluation of three systems. The basis of contract award was on a best-buy assessment by the Government through a Source Selection Evaluation Board (SSEB). Boeing Aerospace manufactured and delivered the Avenger Systems. Also, they were responsible for the delivery of concurrent spares/repair parts for unit support, verified commercial manuals, initial training for Government personnel, and implementation of interim contractor depot support. Concurrent spares/repair parts in the form of Mandatory Parts Lists (MPLs) and Authorized Stockage Lists (ASLs) to support unit maintenance is required with the deliveries. Successful completion of the Avenger Physical Configuration Audit (PCA) resulted in a Government Control System Technical Data Package (TDP) suitable to support competitive procurement of spares and repair parts. In order to obtain a TDP to support this, the Government paid license fees and royalties to Boeing to remove proprietary marking on the TDP. [Ref. 22:p. 2-3]

1. Life Cycle Costs

A Life Cycle Cost (LCC) estimate is published in the Baseline Cost Estimate (BCE). The BCE is in accordance with DA pamphlets 11-2 (Research and Development), 11-3 (Investment), 11-4 (Operating and Support), and 11-5

(Documentation of LCC Estimates) and the Operations & Support (O&S) Cost Guide. [Ref. 23:p. 3]

The BCE is based on the "BIG 5" format to reflect LCCs for the following categories:

- Research, Development, Test and Evaluation
- Production
- Military Construction
- Fielding
- Sustainment

GFE is broken down into three categories: 1) Stinger Funded, 2), Avenger Funded, and 3) Other Command Funded. The Stinger Funded is included as a memorandum entry only since it is already incorporated into the Stinger BCE.

2. Support Risks

The Avenger support risk is associated with the Automatic Test Equipment (ATE) and supply support and is considered to be medium. The ATE issue is the relatively long lead time associated with the Test Program Sets (TPSs) software for DS/GS support. The initial support concept was two level (Unit and depot) maintenance with depot being accomplished by Interim Contract Depot Support (ICDS). The initial acquisition plan provided for two 12 month options of contractor depot repair and return. The organizational level

supply was accomplished through procurement of supply support packages. [Ref. 22:p. 2-4]

3. Training, Manpower, Skills (Manpower and Personnel Integration (MANPRINT) Requirements)

Additional personnel added to the force structure for Avenger System maintenance will be balanced by a corresponding reduction from the Air Defense Artillery (ADA) Force Structure. The Avenger was designed to be operated by a two-man crew and used BIT/BITE to minimize Annual Maintenance Manhours (AMMH) and levels required by the maintainers. The following Military Occupational Specialty (MOS) designations apply:

14S - Operator

27T - Unit/DS Level Maintainer

35Y - Integrated Family Test Equipment (IFTE) Operator [Ref. 22:p. 2-5]

4. Source Selection

The competitive range and proposal evaluation consisted of evaluation and rating in the following areas: 1) Operational Suitability, 2) ILS/Reliability, Availability and Maintainability (RAM)/MANPRINT, 3) Technical, and 4) Cost/Price. The award was made on the basis of the best value to the Government considering Operational Suitability, ILS/RAM/MANPRINT, Technical, and Cost. [Ref. 22:p. 2-5]

5. Reliability Program

The reliability program covers the Avenger System, including the Avenger Pre-planned Product Improvement (P^3I), in compliance with MIL-STD-785. [Ref. 22:p. 2-5]

6. Maintainability Program

A maintainablilty program was established that covered the Avenger, including PMS P^3I in compliance with MIL-STD-470.

7. Quality Program

The Avenger contractor is maintaining a quality program in accordance with MIL-Q-9858A and a software quality program in accordance with MIL-S-52779. These programs include the followings tasks:

- Quality Program Plan,
- Software Quality Evaluation Plan,
- Quality Engineering Plan List,
- Prevention and Conservation,
- Inspection Equipment. [Ref. 22:p. 2-6]

8. Deterioration/Corrosion Prevention

The Avenger includes materials, processes, and parts that minimize system deterioration and corrosion in accordance with MIL-STD-186 for surface preparation, paints, and finishes, and MIL-STD-1250 for protection of electronic assemblies. [Ref. 22:p. 2-6]

D. ELEMENTS OF SUPPORT ACQUISITION

1. ILS Program

The contractor has a formal organizational structure necessary to plan, analyze, manage, implement, integrate, and execute the ILS program. The contractor's ILS organization is at a management level commensurate with managers for cost, schedule, and performance. [Ref. 22:p. 2-7]

2. ILS Management Team

The contractor provides representation to a joint Government/contractor ILSMT chaired by the Government to monitor status of the ILS program.

3. Integrated Support Plan

Boeing prepared the Integrated Support Plan (ISP). The plan described the ILS organization, interfaces between organizations, and logistics policy.

4. Contractor-Developed Equipment/Government Furnished Property

The contractor has established an ILS program to encompass all contractor developed equipment.

5. Transportability

The system conforms to transportability criteria established in AR 70-41, AR 70-47, and MIL-HANDBOOK 157. It is packaged, marked, and labeled for transportation on a worldwide basis by available commercial and military air (C-130, C-141, and C-5), rail, highway, and ocean modes in accordance with applicable regulations. All elements of the

Avenger are to be deployed by U.S. military aircraft without disassembly of the major components/subsystem.

Transportability requirements were considered in the design of the Avenger. Transportability design criteria and constraints were identified throughout the LSA process. Transportability clearance diagrams were provided by the contractor. A transportability report on the Avenger was submitted to the Military Traffic Management Command (MTMC) for coordination, review, and approval. Requirement for airdrop is a P^3I initiative. [Ref. 22:p. 2-8]

E. LOGISTICS SUPPORT ANALYSIS STRATEGY

LSA/LSAR program were tailored to the NDI characteristic of the Avenger program, in accordance with MIL-STD-1388-1A and MIL-STD 1388-2A for all peculiar subsystems, support equipment, and training equipment. For off-the-shelf Army inventory items, existing LSA and Manufacturing Engineering Analysis (MEA) were obtained for use in the ILS development. Task analyses are in sufficient detail to identify tools, support equipment, spares, skilled manpower requirements, and categories of maintenance (unit, DS/GS, depot).

LSA data processing was performed with software established and maintained by the contractor which stored, processed, and retrieved LSAR-automated data. All LSAR data records are automated. [Ref. 22:p. 2-9]

1. Logistics Support Analysis Application to ILS Elements

The logistics documentation produced for the Avenger System identifies resource requirements in terms of the following:

- maintenance planning,
- manpower and personnel,
- supply support,
- support equipment/Test Measurement and Diagnostics Equipment (TMDE),
- training/training devices,
- technical manuals,
- computer resources support,
- packaging, handling, and storage,
- transportability,
- facilities requirements,
- standardization and interoperability. [Ref. 22:p. 2-9]

2. Structure of the Logistics Support Analyses Record

The LSAR and ADP System for the Avenger System was developed in accordance with MIL-STD-1388-2A. The contractor for the Avenger System established, and is maintaining, for the contract duration, an ADP System to store, process, and retrieve LSAR automated data. [Ref. 22:p. 2-10]

3. LSA Verification

LSA verification is an ongoing process using the Avenger hardware when available. Results of all testing is

being reviewed and incorporated into the LSA database if required. [Ref. 22:p. 2-10]

4. Failure Factors

Failure factors are computed in accordance with AMC-P 750-5 and worksheets are prepared in accordance with DI-E-5350. Failure factors are converted to maintenance replacement rates. [Ref. 22:p. 2-10]

5. Army-Contractor Interrelationships in Conducting LSA

The adequacy of the data products resulting from the LSA process, recorded in the LSAR described in MIL-STD-1388-2A, are being evaluated and verified by a Government LSA review team in accordance with AMC-P 700-11. [Ref. 22:p. 2-10]

6. Source of Logistics Support Analysis Documentation

Inputs to the LSA process and the LSAR were derived from the following:

- system concept,
- maintenance concept,
- RAM requirements and data,
- Reliability Centered Maintenance (RCM) analysis,
- engineering drawings,
- maintenance procedures,
- Non-developmental Item Candidate Evaluation (NDICE), Force Development Test and Experimentation (FDT&E-I)/FDT&E-II, Initial Operational Test and Evaluation (IOT&E), and Production Qualification Test (PQT) test results,
- Special Facilities Requirements Analysis,

- Special Training Requirements Analysis,
- Special Support Equipment Requirements Analysis. [Ref. 22:p. 2-11]

F. SUPPORTABILITY TEST AND EVALUATION CONCEPTS

1. Test and Evaluation Master Plan (TEMP)

The TEMP is the top level test and evaluation (T&E) management document. The TEMP clearly identified specific ILS-related test requirements. The TEMP summarized the FDT&E/IOT&E and the PQTs which have been accomplished on the Avenger System. The TEMP was prepared to support the NDI and was coordinated with the Test & Evaluation Command (TECOM), the Training and Doctrine Command (TRADOC), the Army Material Systems Analysis Activity (AMSAA), the Logistics Evaluation Agency (LEA), USAADASCH, and the U.S. Army Logistics Management College. [Ref. 22:p. 2-11]

2. NDI Candidate Test Evaluation

The NDI candidate evaluation test was performed in two Phases. Phase I, the Requirements Demonstration, addressed the operational and technical issues. Phase II, the Limited Environment Evaluation, subjected each candidate to a selection of the more severe, natural, and induced Avenger environments. The candidates were subjected to tactical vibration, temperature shock, rail impact, electromagnetic radiation, and blowing rain. A test of three different candidate systems was conducted to provide data to the SSEB to assist in

selecting the weapon system which would provide the most effective LOS-R Air Defense. Competition was conducted by the Air Defense Board and evaluated by the U.S. Army Operational Test and Evaluation Agency (OTEA). This phased included live fire and tracking tests against surrogate threat aircraft. [Ref. 23:p. 9]

3. Initial Operational Test and Evaluation (IOT&E) Outline

IOT&E continued the ongoing assessment of the operational suitability and overall effectiveness of the Avenger. The IOT&E was managed and evaluated by the U. S. Army Operational Test and Evaluation Agency. The detailed test plan contained field scenarios to verify the operational effectiveness of the system on a representative "slice" of the battlefield under realistic conditions. System tactics, training, and doctrine with user troops were evaluated during this test. The objective of the IOT&E was to provide operational data to support the full-scale production decision. [Ref. 24:p. 9]

The Avenger support for First Unit Equipped (FUE) was in place during IOT&E. The test was supported by the FUE unit ASL/MPL. Organic maintenance capability was available at the unit level. The unit level mechanics removed/replaced LRUs as detected by BIT/BITE. Maintenance above the unit level was provided by the contractor as ICDS. Nonpeculiar Avenger equipment (e.g., HMMWV, radios, etc.) was maintained in

accordance with existing maintenance concepts for that equipment. [Ref. 22:p. 2-12]

G. ILS ELEMENT PLANS

Each of the ILS elements are addressed for the Avenger to resolve associated issues to acquire and deploy a system that can be adequately supported in the field at an economical cost. The Avenger will ultimately be supported through the standard Army logistics system to achieve adequate support at an economical cost. [Ref. 22:p. 2-12]

1. Design Influence

Since the Avenger is an NDI system, ILS influence on design was limited to MANPRINT constraints. Avenger does not degrade the safety features of the GFP elements involved. Safety features of the Avenger System provide maximum safety and protection of operating and maintenance personnel and associated equipment. The system and support equipment do not present any catastrophic or critical hazard as defined in MIL-STD-882, and conform to the safety design criteria of MIL-STD-1472. [Ref. 22:p. 2-12]

2. Maintenance Plan

a. Maintenance Concept

The Avenger System will be maintained using the Standard Army Maintenance Concept as defined by LSA. Because Avenger is an NDI system with a compressed acquisition schedule, insufficient time existed to develop full, organic

maintenance support before FUE, therefore, Avenger-peculiar equipment was initially maintained at Organic Unit Maintenance and ICDS. [Ref. 23:p. 9]

Communications Security (COMSEC) equipment will be removed at unit level and evacuated through existing COMSEC maintenance channels for repair and return or direct exchange. The missile round used with the Avenger System will be obtained from existing stocks of Stinger MANPADS missiles, and will, be supported in accordance with the current Stinger maintenance concept. The Captive Flight Trainer (CFT) and Field Handling Trainer (FHT) will be supported in a like manner.

The HMMWV will be supported in accordance with the existing HMMWV maintenance concept. [Ref. 22:p. 2-14]

b. Unit Maintenance

MOS 27T will be the Avenger System maintainer for unit, DS, and GS maintenance. Unit maintenance of the Avenger subsystems will consist of preventive maintenance checks and services, fault isolation of defective components, and replacement of defective components in accordance with a Maintenance Allocation Chart (MAC). The Prescribed Load List (PLL) will be used by unit maintenance personnel for replacement of faulty LRUs. Unit maintenance of the missile rounds and training devices will consist of preventive maintenance and correcting visibly detected faults on the

exterior of the equipment, and the replacement of selected external components as specified in TM 9-1425-429-12 and TM 96920-429-12. Unserviceable missiles will be exchanged with the support Ammunition Supply Point (ASP) for evacuation to depot repair facilities. Unit maintenance for the SVML and its interface electronic subsystem consists primarily of LRU replacement, using BIT for fault isolation. Unit maintenance for conventional automotive, armament, and signal equipment will be accomplished by battery-maintenance personnel as specified in the applicable lubrication orders, technical bulletins, and technical manuals. [Ref. 22:p. 2-14]

c. Direct Support (DS)/General Support (GS)

DS/GS support capability was not fielded for Avenger unique equipment during the ICDS period. LSA performed during the ICDS period defined the extent of DS/GS support for the deployed systems. The 27T at DS/GS performs all equipment maintenance tasks as identified on the MAC, maintains operational floats, and assists the 35Y in repair of LRUs. The 35Y operates/maintains the Base Shop Test Facility (BSTF) and test/fault-isolate/repair LRUs/SRUs using Avenger TPS on the BSTF. Existing conventional DS/GS level support capabilities for repair of automotive, communications, COMSEC, armament, and power generation equipment will be used to the maximum extent possible for repair of nonpeculiar Avenger components and subassemblies. Recharging of the coolant

bottles, using the single chamber recharger (SCR) or gas pumping unit (GPU), will be accomplished by the utilities equipment repairer (MOS 52C) as presently done for MANPADS or other trained personnel. DS and GS maintenance and supply requirements will be determined and actions will be taken to plan, program, and budget for Integrated Family of Test Equipment (IFTE) and repair parts to support the requirements. [Ref. 22:p. 2-15]

d. Depot Maintenance

Depot maintenance work requirements will be determined by the LSA process and identified by the LSAR. A depot maintenance study was developed to determine the manpower, skills, tooling, test equipment, and facility space and design requirements necessary for depot support of the Avenger System. Depot Maintenance of the missile rounds, CFT, SVML, and FHT was based on the current maintenance concept for these items. [Ref. 22:p. 2-15]

e. Interim Contractor Depot Support

Depots were going to be established at Fort Bliss and Fort Hood to support all CONUS installations and one in Europe to support all U.S. Army Europe (USAREUR) installations prior to U.S. Army support being put in place. Spares and repair parts to perform contractor maintenance functions were going to be stocked to ensure a repair turnaround-time of 30 days or less. [Ref. 23:p. 9] Depots at Fort Bliss and Fort

Hood were set-up. Europe's depot did not get set-up because fielding prorities went to Korea and Desert Storm had just started.

(1) Army Organic Depot Support. The Army Avenger Depot Support Plan did include complete Army organic depot support for Avenger. Depot maintenance plant equipment (DMPE) requirements were determined and action was taken to plan, program, and budget for DMPE and IFTE to support the depot. Action was taken to plan, program, and budget for TPS to test depot maintenance coded items of IFTE/DMPE and for depot repair parts to support the depot maintenance program. A capability was developed for a depot maintenance overhaul program for Avenger to include depot maintenance work requirements (DMWRs). [Ref. 22:p. 2-15]

(2) Maintenance Planning. The Avenger System used the four maintenance support levels while transitioning to the organic four level maintenance concept:

PHASE I: INITIAL MAINTENANCE STRUCTURE WITH ICDS

- This maintenance support was to use two of the four maintenance support levels (unit and ICDS/depot). The two level maintenance concept was to be used due to Avenger NDI design.

PHASE II: TRANSITION OF 24N TO 27T(-)

- This maintenance concept was based upon the new TRADOC Support Structure of replacing currently trained Unit Maintainer (UM), 24N MOS personnel with Ordnance Direct Support (DS) 27T personnel. The 27T MOS was trained in UM as well as DS/GS maintenance tasks, but will not receive training on the Contact Test Set (CTS) nor the CTS or TPS which is the primary reason for the 27T (-) designation. Neither the CTS

nor TPS were available during the 24N to 27T (-) transition period. During this transition period there were only two maintenance levels (UM and ICDS). Once organic maintenance is in place the 27T (-) will become a 27T and perform UM/DS/GS maintenance tasks.

PHASE III: TRANSITION FROM ICDS TO ORGANIC

- In this phase the 27T will be the Avenger System maintainer UM/DS. Organic DS, as well as Depot Support, will begin the transition from ICDS to organic. [Ref. 22:p. 2-18]

H. MANPOWER FORCE STRUCTURE ASSESSMENT

The Avenger System will be operated by existing MANPADS personnel and maintained within the current force structure. Additional personnel will not be added to the force structure as a result of the Avenger System deployment; however, several MOSs may be impacted. [Ref. 22:p. 2-18]

1. Operator Maintenance Personnel

Operator tasks must be achievable to the time and error standards specified below by soldiers with Armed Forces Qualification Test (AFQT) scores equal to the 31st percentile or higher. The current aptitude area score requirement for Stinger crewmen (MOS 16S) is 90 or higher. Maintainer (MOS 24N/27T) tasks must be achievable by soldiers with AFQT scores equal to the 50th percentile or higher. Current Short Range Air Defense (SHORAD) maintainer aptitude area is an Electrical Aptitude Test (EL). Equipment design and/or maintenance concepts to lower the AFQT percentile requirement to the 31st percentile is desired. [Ref. 22:p. 2-18] Operator and maintainer tasks must be achievable by soldiers with a

physical profile of at least 111211 as defined by AR 40-501, and normal color vision. [Ref. 25:p. 77]

2. Human Performance Human Engineering

Human performance requirements are those demands placed on system personnel which are integral determinants of system performance in terms of budgeted time and error (or precision). Human engineering requirements design conform to MIL-STD-1472 with the following exceptions:

- Paragraph 1.3 - The male-only provisions are invoked for application to fire mission crew equipment.

- Paragraph 5.13.7.4.2 - The equation in 3.7.5 of MIL-HDBK-759A, cited in line 8, is changed so that the final denominator reads 1403, rather than 1316; the A values of table 3-5 of MIL-HDBK-759A, cited by the parenthetical statement in line 11, are changed from 365, 211, 155, 119, 97 to 442, 255, 188, 144, and 117 respectively; the final B value of the same table is changed from 3536B to 2921. [Ref. 22:p. 2-19]

I. SUPPLY SUPPORT

1. Supply Concept

The Avenger, an NDI system, was being fielded prior to achievement of total organic supply support capability. This was accomplished through the procurement of MPL and ASL items recommended by the contractor and screened and approved by MICOM. [Ref. 23:p. 97] National Stock Numbers (NSNs) were assigned to MPL/ASL items so existing supply procedures could be used to requisition replacement spares and repair parts in accordance with AR 710-2 and AR 725-50. Requirements will be determined through LSA, processed through the Commodity

Command Standard System (CCSS), which will identify ASL and PLL (in place of MPL) support items and establish Supply Support Requests (SSRs)for other managed items. Transition will include the introduction of intermediate level repair parts and the backfill of these items to existing MPLs/ASLs. Total organic supply support was established on 1 Oct 91. [Ref. 22:p. 2-19]

2. Provisioning

The contractor established and maintained a provisioning program in accordance with the requirements in MIL-STD-1388-2A, MIL-STD-1561B, Provisioning Requirements Statements (PRS) DD Form 1949-2, and the LSAR Data Selection Sheet (Part II) DD Form 1949-2.

The contract provided the following Provisioning Technical Documentation (PTD) as required:

- Provisioning Parts List (PPL),
- Long Lead Time Items List (LLTIL),
- Interim Support Items List (ISIL),
- Common and Bulk Item List (CBIL),
- Post Conference List (PCL),
- Provisioning and Other Preprocurement Screening Data,
- Provisioning Parts List/Index, (PPL/I)
- Provisioning Impact Statement for Class I Engineering Change Proposal (ECP)
- LSAR Pricing Plan.

Engineering design changes made after PCL delivery which are the result of ECPs, will be delivered to the Government via Design Change Notice (DCN). All provisioning data delivered to be loaded into the MICOM CCSS must meet the ADP routine with a 98 percent acceptance. [Ref. 22:p. 2-20]

3. Operational Readiness Floats (ORF)

An ORF of 10 percent is authorized in accordance with AR 750-1. The floats are located at each support unit.

4. Support Equipment

Peculiar support equipment is recommended only when standard support equipment or existing Army inventory tools and test equipment did not fulfill the maintenance requirements as determined by LSA. [Ref. 22:p. 2-20]

5. TMDE Requirement

TMDE has been identified and determined through the LSA process. TMDE development, registration, and acquisition approval is in process of being accomplished in accordance with AR 750-43. TPS's for the Avenger Weapon System's ATE were developed in accordance with the TPS Management Plan.

6. Guided Missile Coolant Recharging Unit, GCU-31/E

Each support unit was authorized a GCU-31/E. It is a self-contained unit measuring 24 inches wide by 20 inches high by 34 inches long and weighs approximately 175 pounds. The case is pressure molded fiberglass with a shock mounted aluminum liner rack, removable front, and rear covers with

gaskets designed to provide environment protection. The GCU-31/E uses an air operated, reciprocating, single stage booster compressor that boosts the pressure of incoming argon gas to 6000 psi. [Ref. 22:p. 21]

J. TRAINING PLAN

A comprehensive training plan has been prepared. The training plan includes a training program for Avenger crew personnel to train in the operations and maintenance of the system and to train maintenance personnel at higher levels of maintenance as prescribed by the LSA process.

1. Training Development

- U.S. Army Air Defense Artillery School (USAADASCH) is the Army's training proponent and will assist MICOM New Equipment Training (NET) monitoring contractual requirements for training products to support the training of operators.

- U.S. Army Ordnance Missile and Munition Center and School (USAOMMCS) is the Army's proponent for all maintenance and will develop training and training products to support the training of maintenance personnel as dictated by LSA.

- USAADASCH was to incorporate required Avenger operator instructions into applicable manuals. SQTs will be modified, as required. [Ref. 24:p. 12]

- ARTEPs were to be updated as soon as possible after Tables of Organization and Equipment (TOEs) became available.

2. Government Supported Training

- New Materiel Introductory Briefing Team (NMIBT)

-- To be conducted at the gaining unit prior to each deployment.

- New Equipment Training Team

-- New Equipment Training Teams (NETTs) and exportable training packages have been provided for Avenger. All potential operators will receive training. This training will be conducted in the unit area.

-- The divisions are required to provide physical facilities, administrative, and logistics support.

-- Training Support Requirements, two classrooms for 30 students each and facilities to house FUs and training devices for training maintenance. Facilities are located one square mile outside training area for operator PEs. Units that received training provided and operated RPVs for tracking. Units provided secure storage for classified FUs components and machine guns, range facilities with tactical aircraft for one day.

- Tactics, Technique and Procedures (TTP)

-- TTP is necessary for operator crew through senior commanders. The USAADASCH & OMMCS provided instructors for DTT. USAADASCH and OMMCS integrated tactics, techniques, and

procedures into NCO and Officer courses and included it in the appropriate field manuals and training circular.

[Ref. 22:p. 2-22]

3. Contractor Presented Training (MICOM NET managed)

a. Staff Planner Course

Staff planner course description is system orientation, including logistics support and tactical employment to high level management, planning, and supervisory personnel associated with the Avenger program.

b. Instructor and Key Personnel (I&KP) Courses

Operator and unit maintenance I&KP classes were conducted and intermediate maintenance classes are planned as follows:

- Operator Course

-- Course Description - To train instructor and key personnel who are representatives of the field population to operate the Avenger equipment.

c. Captive Flight Trainer

CFT will be used to train gunners in the technique of acquiring, tracking, and engaging targets.

d. Training Facilities

No additional training facilities are required.

[Ref. 22:p. 2-24]

K. TECHNICAL MANUALS

Contractor prepared (Department of the Army Technical Manual (DATM) converted) manuals will be used to support the Avenger. These include the presently available Operator's Manual (TM 9-1425-433-10) and Unit Maintenance Manual with Repair Parts and Special Tools List (RPSTL)(TM 9-1440-433-20&P) prepared in accordance with the requirements of MIL-M-7298C.

An Engineering Services Memorandum (ESM) contract is presently in place to provide timely updates to the above described TMs. The TMs will also reflect approved LSA/LSAR changes and will be validated and verified using production hardware. [Ref. 22:p. 2-24]

The Technical Data Package (TDP) required for the Avenger is a level 2 TDP suitable for competitive procurement per DoD-D-1000 and DoD-STD-100 and product process material specifications per MIL-STD-490 and MIL-S-83490.

L. COMPUTER RESOURCES SUPPORT

A Computer Resources Management Plan (CRMP) will implement the requirements of MICOM policy 70-2, Management of Computer Resources Embedded in Missile Battlefield Systems, that are not presently covered in the Stinger System Software Plan. It will also serve as a secondary purpose in supplying information when dealing with Avenger software upgrades or more importantly Product Improvements.

1. To maximize compatibility of software decisions and in some cases hardware, when it affects software pertaining to Avenger, this plan defines the coordination to be affected; the procedures to be followed; and the responsibilities of each organization in establishing approved baselines, controlling changes, defining interfaces, providing required software configuration management, engineering, funding, logistics, and in process reviews.

2. The Avenger System has been integrated under a single contract, awarded in fiscal year 87 to Boeing, Huntsville. Boeing has subcontracted the software and computer system to General Electric. Boeing's responsibilities are:

- definition and accomplishment of all software growth programs (e.g., development of any new software in consonance with the evolving threats, etc.);
- system software engineering requirements which would define requirements for growth activities as well as maintenance;
- system integration;
- engineering services;
- production.

3. Initially the Stinger Project Office (SPO), then the Avenger Project Office, had overall management responsibility. The main responsibility for the supervision and coordination of software upgrades, whether they be for product improvements or maintenance, will fall on the System Engineering Division which reports to the Project Manager.

4. This plan started during the production phase and will remain effective throughout the Life Cycle Management phases as the SPO warrants.

5. This plan became effective upon approval by the SPO and remains in effect for the life cycle of the Avenger System or until superseded, rescinded, or modified by mutual consent of the SPO. This plan will be reviewed annually or as required during Avenger Computer Resources Working Group (CRWG) meetings. [Ref. 22:p. 2-25]

M. PACKAGING, HANDLING, AND STORAGE (PHS)

Preservation and packing methods used for the Avenger components will be in accordance with:

1. MIL-P-116, Method of Preservation Packaging;

2. MIL-P-14232, Packaging and Packing of Parts, Equipment, and Tools for Army Materiel;

3. AR 746-1, Packing of Army Materiel for Shipment and Storage;

4. ASTMD-3951, Commercial Packaging of Supplies and Equipment. The example packaging definitions listed in MIL-E-17555, Packaging and Packing of Electronic and Electronic Equipment, Accessories, and Repair Parts, may be used for guidance when selecting unit package methods and preservations of MIL-P-116. Packaging instructions will be prepared for each provisioned item of the launch system, spare repair part,

and ancillary equipment. Packaging data will be developed and documented in accordance with MIL-STD-2073.

N. TRANSPORTATION AND TRANSPORTABILITY

1. Transportation of Materiel

Materiel will be moved in accordance with the Military Traffic Management Regulation, AR 55-355, and Military Standard Transportation and Movement Procedures (MILSTAMP), DoD 4500.32R. Sensitive items will be provided transportation protective services in accordance with standards specified in DoD 5100,76M and AR 55-355, Chapter 26. Security classified items will be shipped in accordance with the regulation providing the most stringent protective measures where possible. [Ref. 22:p. 2-27]

2. Transportability

The Avenger, less ordnance, will be transportable worldwide by all transportation modes without sectionalization. Two systems will be transportable aboard one C-130 aircraft without demating or modification of the system in accordance with MIL-STD-209G. The capability to deliver Avenger by airdrop without missiles is required. Low Altitude Parachute Extraction System (LAPES) without missiles is desired. The Avenger System without missiles will be sling-liftable by a CH-47 helicopter; lift by a UH-60 helicopter is desired. The contractor prepared a

transportability report and a transportability clearance diagram in a vehicle-mounted configuration. [Ref. 22:p. 2-27]

O. FACILITIES REQUIREMENT

Sustainment training of the Avenger teams in field operations will be accomplished using the existing MANPADS FHT, the existing MANPADS THT, and a new Avenger unique CFT. There will be no change in the storage requirements for the FHT and THT. The Avenger unique CFT, which is 66 inches by 13 inches by 13.25 inches, and weighs 75 pounds, is classified Confidential and requires physical security at the organization level in accordance with AR 190-11 and AR 380-5. The firing range will be safety certified for laser operations in accordance with TB MED 279, dated 30 May 75. [Ref. 22:p. 2-27]

1. Maintenance

Facilities during the ICDS period were the responsibility of the contractor unless Government facilities already existed. After this time, the DS/GS facilities will be the responsibility of the using unit and depot facilities will be at ANAD (recently changed to Letterkenney Depot).

The Avenger has a SCR for pumping argon gas which is approximately 34 inches by 24 inches by 20 inches, and weighs 175 pounds. A compressor reciprocating, air, tank mounted, gasoline engine driven, 15 CFM, 175 psi is required for operation. The SCR will replace the existing GPU on a one-

for-one basis and is to be installed in the same facility as the existing GPU.

The modifications to the standard M998 HMMWV will include a 8660 pound gross vehicle weight suspension, a 100 AMP alternator, a blast cab, and a ballistic windshield. [Ref. 22:p. 2-28]

2. Supply and Storage

Based on current criteria (length plus two feet and width plus two feet), the following is a comparison of the parking space requirements for the Avenger team vehicle and MANPADS team vehicles for those units where the MANPADS teams have not been issued the HMMWV.

In the combat loaded configuration, each Avenger team has eight missiles while each displaced MANPADS team had six missiles. Additional magazine storage of 24 cubic feet per team may be required for the receiving unit. The Avenger team has a .50-caliber machine gun that the MANPADS team did not have, which may require the storage of additional .50-caliber ammunition. The combat load for the machine gun is estimated at 600 rounds per day for a total of 1800 rounds based on a 3 day scenario.

Stinger Missiles (FIM-92A, FIM-92B, and FIM-(92C), are classified as Class V Explosives. Handling and storage will conform to the following publications.

- AR 190-11 (Physical Security Weapons, Ammunition, and Explosives, dated 30 March 77).
- DoD 5100.76M (Physical Security of Sensitive Conventional Arms, Munitions and Explosives, dated Feb 83).
- DoD 6055.9-STD (Ammunition Explosives Standards, dated July 84).

Stinger Missiles are containerized for shipment and storage. Each container holds one missile. Missiles will be shipped nine per pallet, and arranged three wide by three deep. [Ref. 22:p. 2-29]

P. STANDARDIZATION AND INTEROPERABILITY

Standard off-the-shelf components were used in the Avenger system where possible. Like units, assemblies, subassemblies, and replaceable parts are physically and functionally interchangeable without modification of such items or the equipment. All external and internal dimensions, covers, cavities, locations of hinges, fasteners, connectors, locking pins, slides, mountings, other mating parts, and size and form of special threads will conform to the interchangeability requirements of MIL-I-8500 and MIL-I-8500 and MIL-STD-280. The system interfaces and functions with standard unmodified Basic Stinger, Stinger-Post, and Stinger-RMP missile rounds. Stinger missile performance must not be degraded. [Ref. 22:p. 2-29]

Q. SUPPORT TRANSITION PLANNING

Maintenance Planning, identifies maintenance transition from interim contractor depot support (ICDS) to organic depot support. [Ref. 22:p. 2-29]

R. SUPPORT RESOURCE FUNDS

1. ILS Funding

Funding requirements to support the initial ILS for the Avenger was incremental. Additional funding has been developed for each of the Program Objectives Memorandum (POM) year~ as required. Funding requirements are not included but can be made available on a need to know basis to Government agencies. [Ref. 22:p. 2-29]

2. Fielding and Sustainment Funding

The resources to support the fielding and sustainment of the Avenger is reflected in Army Modernization Information Memorandum (AMIM) number 1036 (DA PAM 5-25). [Ref. 22:p. 2-30]

S. POST FIELDING ASSESSMENTS

After initial materiel fielding, ILS management efforts are directed toward improving subsequent fielding, readiness and sustainability, reducing operating and support costs, and reducing the overall life cycle cost of the Avenger.

MICOM leads the post-fielding assessment and post-production planning efforts, with participation from USAADASCH, LEA, gaining units, and others as required. This

assessment is conducted for each unit 12 to 18 months after each deployment.

Gaining units provide a candid assessment of strengths and weaknesses of the manpower, training, and logistics support provided as well as a broad assessment of the overall performance of Avenger. Within 1 year after each Avenger fielding, the MICOM Missile Systems Readiness Directorate conducts a Force Modernization Post-Fielding Assessment Visit. The primary objectives of these visits are:

- determine readiness impact of the Avenger;
- keep the Command Group informed of the overall adequacy and status of the fielding process;
- assess the adequacy of Materiel Fielding Plans (MFPs), Memorandums of Understanding (MOUs), NET, Total Package Unit Materiel Fielding (TP/UMF), and related fielding issues. [Ref. 22:p. 2-33]

T. POST-PRODUCTION SUPPORT

1. Reporting Procedures

The Avenger publications will incorporate the standard Army reporting procedures for equipment improvement recommendations (EIR) and quality deficiency reports (QDR). [Ref. 22:p. 2-30]

2. Formal Data Collection Programs

The Avenger Sample Data Collection (SDC) program collected data from two (2) batteries (Fort Hood, TX, and Fort Stewart, GA). There was one contractor at each location to

interface with the troops for data collection. It was geared to collecting information by on-site personnel through study or actual field experience. The information collected was geared to correction of design concept changes where appropriate. AR 750-37, as supplemented by AMC and MICOM, and DA PAM 738-750 describe methods and procedures for data collection programs. [Ref. 22:p. 2-30]

3. Modification

Subsequent to Initial Operational Capability (IOC), all modifications resulting from issuance of DA Modification Order (DAMWO) are applied by either the contractor or Government teams furnished with AMC resources. Additionally, applications for the modifications are blocked, where appropriate, to reduce cost and improve control and management of the modifications program. [Ref. 22:p. 2-30]

4. Warranties

The Avenger and SVML warranty coverage are administered by the U.S Army Missile Command in accordance with procedures in the warranty TB 9-1430-433-14, dated 3 April 1989.

a. Coverage

The Avenger and SVML are warranted for 36 months after acceptance by the Government. The warranty covers any fault failure not attributable to abuse. The warranties do not apply if failure is due to obvious induced damage caused

by maintenance error, operation beyond limits, or foreign object damage.

Warranted LRUs for the Avenger and SVML are identified per an affixed label stating that the item is warranted until the stated expiration date. Each warranted LRU for Avenger and SVML has one warranty label.

b. Contractor Responsibilities

If an Avenger or SVML fails to meet the contractual warranty requirements, the contractor is required by the Government, at no cost to the Government, to take corrective action in accordance with the following:

- The contractor promptly repairs or replaces such parts as are necessary to achieve the specified performance requirements, and the contractor bears the cost thereof.

- If the contractor fails to repair or replace such parts within a reasonable time, as determined by the contracting officer, the contractor shall pay the costs incurred by the Government in procuring such parts from another source and in accomplishing the repair. However, prior to effecting procurement repair from another source, the Government will notify the contractor of such proposed action and shall specify a time limit for contractor initiation of repair.

- When items covered under this guarantee are repaired or replaced, pursuant to this clause, the contractor has the option of repair or replacement on the site at which the hardware is located. Any Government owned facilities and/or test equipment located at the site of the failed defective hardware is made available to the contractor, on a rent free, noninterference basis, for the repair or replacement of failed or defective hardware. In the event it is not feasible to repair replace and retest on site, the contractor will bear the normal transportation costs for Avenger only. The Government is liable for transportation costs for SVML.

- The contractor will have reasonable access to Government records related to storage, inspection, maintenance, operations, and repair at the place where such records are kept and can use and or copy records at the contractor's expense. The contractor may review, from time-to-time, the Government's maintenance and operation facilities. [Ref. 25:p. 3]

U. ANALYSIS OF THE AVENGER ILSP

The primary objective of the Avenger Integrated Logistics Support Plan in acquisition is to achieve system readiness objectives at an affordable life cycle cost. The ILS program begins at program initiation and continues for the life of the system. Within the ILSP determination for support requirements and design support characteristics are thoroughly investigated.

1. Critical operational issues

One failure is the built-in-test and built-in-test-equipment(BIT/BITE) which did not achieve the required level of fault identification and isolation, finding and isolating (to both 5 and 1 LRU) less than half the required percentage of faults. Part of the failure stems from the unusual situation of the ROC requiring identification of faults in the basic vehicle without any test equipment to locate them. [Ref. 26:p. 3] The ROC may be modified to remove this requirement. However, this will not completely solve the problem. Even with the ROC change, the BIT/BITE will require improvement in its ability to isolate faults to a single LRU.

2. Avenger, LOS-R component of the FAAD system, provides low-altitude air defense for mobile and stationary critical assets of corps and heavy, light, and special divisions while operating outside direct fire and observed, indirect fire ranges. [Ref. 26:p. 23]

3. The Initial Operational Test and Evaluation and Production Qualification Tests have been completed. Initially some issues existed concerning environmental and safety qualification. The most significant of those issues involved the problem of the Stinger missile backblast that could result in cab panel damage and/or toxic gases entering the cab. The impact was that the azimuth firing angle would have been restricted when firing on-the-move with the driver in the cab. [Ref. 28:p. 1] However, prior to DAB MS III approval based on the PM's recommendation, the cab was stiffened and stronger rivets were used to prevent the backblast problem. There is no longer an azimuth restriction. [Ref. 27]

4. Another deficiency that was discovered during the test program was the build up of heat in the turret under moderately high ambient temperature conditions. This is being corrected by an environmental control unit that is undergoing testing and integration now as part of the P^3I program. [Ref. 28:p. 1]

5. One of the recognized shortcomings of the Avenger system is that it is not capable of being air dropped as a unit since it is about one foot too high to be palletized and

dropped from a C-130. This ROC requirement cannot be met with the present configuration but the system can be dropped demated on a pallet and field remated by the two-man crew. [Ref. 28:p. 1] The user has determined this to be acceptable. Tactics incorporating this will be developed and included in future publications. [Ref. 27]

6. The overall effectiveness of the Avenger at night against current countermeasured threats is limited by virtue of deficient Stinger RMP missile performance. This fact raises the issue of the value added of the Avenger over MANPADS since the Avenger was projected to have an unqualified performance advantage over MANPADS at night. [Ref. 28:p. 1] Avenger still provides improvement over MANPADS, especially at night since it has a FLIR. The missile problem is most accute against certain counter-measures. The Avenger does not impact that adversely. [Ref. 28]

7. One of the unresolved issues is the question of readiness to all surfaces access for nuclear, biological, and chemical (NBC) decontamination. To date, no tests have been done and a TECOM assessment expressed concerns about whether the Avenger could be decontaminated without damage to the critical components. [Ref. 29:p. 3]

V. CHAPTER SUMMARY

The Avenger ILSP primary objective is to achieve system readiness at an affordable life cycle cost. ILS begins at

program initiation and continues for the life of the system. Early Phases determine support requirements and design support characteristics into the system. They also establish manpower, personnel, and training requirements. The ILSP evaluates alternative support concepts, techniques and plans for the conduct of DT&E, R&M and ILS test articles. It establishes system readiness and supportability thresholds for testing prior to DAB milestones and emphasizes realistic budgets for support resource acquisition.

The Avenger ILSP is tailored to the specific needs of the Avenger program and addresses the total materiel system including each of the elements of logistics. The ILSP is the implementation plan for all participating activities and is treated as an integral part of the program plan.

Effective implementation of the ILSP is a major management challenge due to the complexity of materiel systems and the multitude of interfaces, and especially for an NDI system.

V. MAJOR LESSONS LEARNED

Important lessons learned from the Avenger program include the following:

- NDI acquisition works and should be used whenever possible.

- NDI acquisition appears to be an excellent and cost effective way to meet Army materiel requirements. This is especially true for command, control and communications systems where the civilian sector has similar needs. Procuring NDI command, control and communications systems allows the military to remain current with new technology, while at the same time saving considerable research and development cost. Avenger is the Army's best example of NDI and a good example of an effort to procure the best available system.

- Stable funding and congressional support are necessary for any program, even NDI. Funding must be stable to avoid turbulence and to take care of unexpected contingencies. Both Boeing and the Army have had to work with HQDA, DoD and Congress to keep the program on track. Also, NDI programs must have the flexibility to accommodate growth and the insertion of new technology within the system's architecture, hardware and software.

- Good people must be selected for the program and remain with the program. With Avenger many of the key players remained with the program. Many moved from the Stinger missile when the Avenger office was created so the institutional knowledge and continuity remained within the Avenger Program Office. Such continuity reduces turbulence and greatly enhances any program, especially a fast-paced NDI effort.

- Market investigation and knowledge are absolutely necessary. The combat developer and the materiel developer must work closely together when requirements documents are being written. The combat developer normally doesn't know what technology is available in the market. Therefore, if the combat developer and the materiel developer don't work together, then a situation could arise where the requirements documents are so demanding that current technology would not be sufficient.

This could lead to an unnecessary expenditure of research and development cost and long term system development and fielding. This is especially true for NDI, since the goal in NDI is to obtain equipment and technology that satisfies user requirements while reducing R&D costs. Write the NDI requirements documents with performance parameters that industry can be expected to attain in the near future.

- Total Package Fielding works for the Government. During the fielding of Avenger Boeing was involved as the technical advisors in the early fielding and remained as a team player throughout the fielding. However, the Government was always in charge, putting together the package, responsible for equipment check-out and handoff.

- Don't proceed to full OT&E until the system, and the testing community are all ready. Identify the criteria for whether or not the Army should proceed to full OT&E. Get the decision makers involved in the fielding and the full OT&E process. Develop realistic criteria for evaluating the level of unit training as well as the capability of the new system. Also, evaluate the testing procedures. Get the contractor involved.

VI. CONCLUSIONS AND RECOMMENDATIONS

A. INTRODUCTION

The focus of this thesis was on the major ILS lessons learned from the Avenger program. The researcher believes the following conclusions and recommendations represent the major lessons learned from the Avenger program.

B. GENERAL CONCLUSIONS

This thesis focused on Avenger Integrated Logistics Support of Non-developmental Items (NDI), since non-developmental items alternatives usually require a departure from traditional support methods. Alternative logistics support strategies were identified. These strategies may enable U.S. Army Program Managers to maximize the benefits of using individualized and tailored support strategies for non-developmental acquisition.

The current concept of NDI does not give sufficient emphasis to the impact ILS has on the NDI nature of the Program. ILS considerations can fundamentally alter the NDI nature of a large program if they differ from those in place. Off-the-shelf may adequately describe the availability of the hardware but it does not describe the capability of the system to fight and be sustained in combat.

C. SPECIFIC CONCLUSIONS

1. NDI Is An Important Acquisition Strategy

Non-developmental item acquisition capitalizes on the use of commercial state-of-the-art technologies while providing DoD with effective and economical solutions to operational requirements. NDI acquisition has shown quality trends to be as good as, if not better than, specially developed items when they are purchased to meet a military requirement. Non-developmental item acquisitions have lowered life cycle costs because NDIs can skip most of the research and development phases of the acquisition process. NDI should be one of the first materiel alternatives considered.

2. NDI Acquisition Strategy Logistics Support Planning

When using an NDI, logistics planning must begin early in the program because of the shorter acquisition cycle. Logistics planners have less time to plan and implement support systems. Fielding schedules could be delayed if the support system is not in place. This early logistics support planning will allow acquisition managers time to properly plan for the support of the NDI. Without adequate logistics planning, system fielding may be delayed because proper support structures may not be in place. In the Avenger program, acquisition managers and contractors realized they did not have adequate logistics support planning time so they used ICS until sufficient support planning could be completed

and a logistics support structure established. The requirements to conduct Logistics Support Analysis and develop Integrated Logistics Support Plans for a non-developmental program do not change, but can be waived.

3. Accelerated Acquisition

In an accelerated acquisition where there is insufficient time available to fully develop ILS, flexibility is a must. More flexibility must be built into large, complex NDIs to allow for future growth and support.

4. Market Analysis for Each NDI Program

Market analysis is important in the acquisition planning process because it can identify possible commercial NDI alternatives. The market analysis reveals the strength of the commercial resource base. A strong resource base usually means more competition, more alternatives, and better quality commercial products. The market analysis also helps identify potential risks and constraints in the acquisition and support strategies. The market analysis should be conducted early in the planning process.

5. Support Strategy Should Be Tailored to the NDI Program

Avenger NDI support strategy was tailored to the program. In order to take full advantage of NDI benefits, acquisition managers must be allowed to structure a program that is different from a full-scale development program.

6. Contractor Support As An Alternative For Every NDI Program

Contractor support can be tailored to almost any support method, even setting up an organic support system. Some programs discovered that contractor support is flexible. The contractor is responsible and preforms all maintenance under the total contractor support method. Interim contractor support can be used to transition programs from one support method to another.

7. Some ILS Considerations Should Not Be Accelerated

There is no substitute for the time required to produce quality TMs, TMDE, tools and facilities. Operational planners must recognize this and be aware of the cost and risks of limited ILS when establishing IOC and deployment plans for items procured in an accelerated acquisition.

D. RECOMMENDATIONS

1. NDI Programs Should Identify Their Support Strategy Early In the Decision Making Process

In order for logistics support to be effective, it must be included early in the acquisition planning process and be considered in formulation of the acquisition strategy. NDIs have a shorter acquisition cycle than full-scale production programs. The support strategy can complement the acquisition strategy with adequate time devoted in the planning process up front and early.

2. For NDI Systems, Supply Support Should Be a Major Evaluation Area In the Source Selection Process

The issue is whether the manufacturer's spares and repair parts concept satisfies the user's needs. To determine this, competitors for production contracts should be evaluated on their ability to provide spares and repair parts as a separate area in the source selection process. Competitors should be evaluated on technical data, breakout, first and second sourcing plans for repair parts, and post-production support.

3. Programs Should Consider NDI As An Alternative Acquisition Strategy

NDI alternatives should be considered as viable solutions to some DoD materiel needs. There are many instructions that require the PMs to consider NDI alternatives in the acquisition planning process. The Government should start developmental programs only if NDIs do not fulfill the user's needs. NDI alternatives should continue to be used to introduce new technologies into existing programs.

4. DoD Should Develop a System to Measure the Effectiveness of NDI Procurement

DoD has no DoD-wide information system to track or measure the effectiveness of NDI procurement methods or the type and degree of non-developmental efforts. Joint NDI programs are used more frequently to reduce costs and meet Service-wide needs. The need for systems integration is increasing, as is the participation of NDIs.

APPENDIX

ACRONYMS

ADA	Air Defense Artillery
ADP	Automated Data Processing
ADT	Administrative Delay Time
AFQT	Armed Forces Qualification Test
AMC	Army Materiel Command
AMIM	Army Modernization Information Memorandum
AMMH	Annual Maintenance Manhours
AMSAA	Army Materiel System Analysis Agency
ANAD	Anniston Army Depot
AR	Army Regulation
ASL	Authorized Stockage List
ASP	Ammunition Supply Point
ATE	Automatic Test Equipment
BCE	Baseline Cost Estimate
BIT/BITE	Built-in Test/Built-in Test Equipment
BSTF	Base Shop Test Facility
CBIL	Command Bulk Item List
CCSS	Commodity Command Standard System
CE/D	Concept Exploration and Definition
CFM	Contractor Furnished Material

CFT	Captive Flight Trainer
COMSEC	Communications Security
CONUS	Continental United States
CP^2	Contractor Performance Certification Program
CRMP	Computer Resources Management Plan
CRWG	Computer Resources Working Group
CTS	Contract Test Set
DA	Department of the Army
DAB	Defense Acquisition Board
DATM	Department of the Army Technical Manual
DCN	Design Change Notice
DEM/VAL	Demonstration and Validation
DMPE	Depot Maintenance Plant Equipment
DMWR	Depot Maintenance Work Requirement
DoD	Department of Defense
DS	Direct Support
DT&E	Development Test and Evaluation
ECP	Engineering Change Proposal
ECU/PPU	Environmental Control Unit/Prime Power Unit
EIR	Equipment Improvement Recommendations
EMD	Engineering and Manufacturing Development
ESM	Engineering Services Memorandum
F^3	Form, Fit, and Function
FAAD	Forward Area Air Defense
FAADS	Forward Area Air Defense System
FDT&E	Force Development Test and Experimentation

FHT	Field Handling Trainer
FMC	Full Mission Capable
FU	Fire Unit
FUE	First Unit Equipped
GCU	Guided Missile Coolant Recharge Unit
GFP	Government Furnished Property
GPU	Gas Pumping Unit
GS	General Support
HDBK	Handbook
HMMWV	High Mobility Multi-Purpose Wheedled Vehicle
HQDA	Headquarters, Department of the Army
I&KP	Instructor and Key Personnel
ICDS	Interim Contract Depot Support
IFTE	Integrated Family Equipment
ILS	Integrated Logistics Support
ILSMT	Integrated Logistics Management Team
ILSP	Integrated Logistics Support Plan
IOC	Initial Operational Capability
IOT&E	Initial Operational Test and Evaluation
ISIL	Interim Support Items List
ISP	Integrated Support Plan
JROC	Joint Requirements Oversight-Rear
LAPES	Low Altitude Parachute Extraction System
LCC	Life Cycle Cost
LEA	Logistics Evaluation Agency
LDT	Logistics Delay Time

LLTIL	Long Lead Time Item List
LOS-R	Line of Sight-Rear
LRU	Line Replaceable Unit
LRIP	Low-Rate Initial Production
LSA	Logistics Support Analysis
LSAR	Logistics Support Analysis Record
MAA	Mission Area Analysis
MAC	Maintenance Allocation Chart
MANPADS	Manportable Air Defense System
MANPRINT	Manpower Personnel Integration
MDT	Maintenance Down Time
MEA	Manufacturing Engineering Analysis
MFP	Materiel Fielding Plans
MICOM	Missile Command
MILSTAMP	Military Standard Transportation and Movement Procedures
MIL-STD	Military Standard
MOS	Military Occupational Specialty
MOU	Memorandums of Understanding
MPL	Mandatory Parts List
MNS	Mission Need Statement
MSE	Mobile Subscribe Equipment
MTBF	Mean Time Between Failure
MTBM	Mean Time Between Maintenance
MTBR	Mean Time Between Repair
MTMC	Military Traffic Management Command

NBC	Nuclear, Biological, and Chemical
NET	New Equipment Training
NETT	New Equipment Training Team
NDI	Non-developmental Item
NDICE	Non-developmental Item Candidate Evaluation
NMIBT	New Materiel Introductory Briefing Team
NS	No Support
NSN	National Stock Number
ORF	Operational Readiness Float
OMB	Office of Management and Budget
OMS/MP	Operational Mode Summary/Mission Profile
OR	Operational Requirement
O/S	Operations and Support
OS	Organic Support
OTEA	Operational Test and Evaluation
P^3I	Pre-Planned Product Improvement
PCA	Physical Configuration Audit
PCL	Post Conference List
PHS	Packaging, Handling, and Storage
PLL	Prescribed Load List
PM	Program Manager; Project Manager; Product Manager
PMS	Pedestal Mounted Stinger
POM	Program Objectives Memorandum
PPL	Provisioning Parts List
PQT	Production Qualification Test
PRS	Provisioning Requirements Statements

QDR	Quality Deficiency Report
RAM	Reliability, Availability and Maintainability
RCM	Reliability Centered Maintenance
RCU	Remote Control Unit
R&D	Research and Development
RDT&E	Research, Development, Test and Evaluation
RFP	Request for Proposal
ROC	Required Operational Capability
RPSTL	Repair Parts and Special Tools List
SAIP	Spares Acquisition Integrated with Production
SAM	Surface-to-Air Missile
SCR	Single Chamber Recharger
SDC	Strategic Defense Command
SECDEF	Secretary of Defense
SHORAD	Short Range Air Defense
SINCGARS	Single-Channel Ground and Airborne Radio System
SQT	Skill Qualification Test
SRO	System Readiness Objective
SRU	Subassembly Repairable Unit
SSEB	Source Selection Evaluation Board
SSR	Supply Support Requests
SVML	Standard Vehicle Mounted Launcher
TC-CLPU	Type-Classified Limited Procurement Urgent
TC-S	Type-Classified Standard
TCS	Total Contractor Support
T&E	Test and Evaluation

TECOM	Test and Evaluation Command
TEMP	Test and Evaluation Master Plan
TDP	Technical Data Package
TLCCS	Total Life Cycle Competition Strategy
TM	Technical Manual
TMDE	Test Measurement and Diagnostics Equipment
TOE	Table of Organization and Equipment
TP/UMF	Total Package/Unit Materiel Fielding
TPS	Test Program Set
TRADOC	Training and Doctrine Command
TTP	Tactics, Technique and Procedures
UM	Unit Maintainer
USAADASCH	U.S. Army Air Defense Artillery School
USAOMMCS	U.S. Army Ordnance Missile and Munition Center and School
USAREUR	U.S. Army Europe
USD(A&T)	Under Secretary of Defense for Acquisition and Technology

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